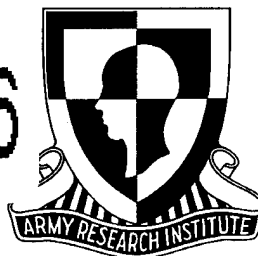# Selection and Effects of Channels in Distributed Communication and Decision-Making Tasks

Stephen Reder and Robert G. Schwab
Northwest Regional Educational Laboratory

Research and Advanced Concepts Office
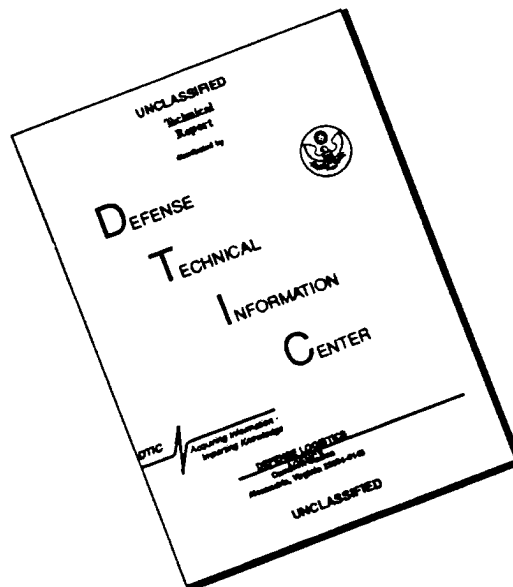Michael Drillings, Acting Director

March 1996

19960815 146

United States Army
Research Institute for the Behavioral and Social Sciences

DTIC QUALITY INSPECTED 1

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

U.S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction
of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Director

Research accomplished under contract
for the Department of the Army

Northwest Regional Educational Laboratory

Technical review by

Michael Drillings

REPORT DOCUMENTATION PAGE

1. REPORT DATE 1996, March	2. REPORT TYPE Final	3. DATES COVERED (from. . . to) July 1986-July 1989

4. TITLE AND SUBTITLE Selection and Effects of Channels in Distributed Communication and Decision-Making Tasks	5a. CONTRACT OR GRANT NUMBER MDA903-86-C-0172
	5b. PROGRAM ELEMENT NUMBER 0601102A

6. AUTHOR(S) Stephen Reder and Robert G. Schwab (Northwest Regional Educational Laboratory)	5c. PROJECT NUMBER B74F
	5d. TASK NUMBER BR43
	5e. WORK UNIT NUMBER C70

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) R&D Center for Workplace Communication Northwest Regional Educational Laboratory 101 SW Main Street, Suite 500 Portland, OR 22333-5600	8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: PERI-BR 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. MONITOR ACRONYM ARI
	11. MONITOR REPORT NUMBER Research Note 96-56

12. DISTRIBUTION/AVAILABILITY STATEMENT

May not be released by other sponsoring organization without the approval of the U.S. Army Research Office.

13. SUPPLEMENTARY NOTES

COR: Michael Drillings

14. ABSTRACT *(Maximum 200 words)*:

This report provides detail descriptions of the results and findings of the 3-year project. Focusing on workgroup tasks and communicative interactions, the methodology developed in this study portrays the fine-grained, dynamic structure of the workday of members of workgroups. Major tradeoffs were found between the resources individuals need to complete their solitary work and those required to support effective communication and cooperation among workgroup members.

15. SUBJECT TERMS

Communication   Decision-making   Tasks   Workgroups

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited	218	

EXECUTIVE SUMMARY

<u>Requirement:</u>

The efficient and effective transfer of information among members of workgroups is the key to successful collaborative efforts. With the continuing evolution of powerful information and communication technologies, organizations are facing the challenge of fitting these technologies to their existing structures or using such technologies to reshape their organization. The ability of an organization to effectively deploy new technologies and implement and guide the accompanying changes in its social organization requires an understanding of the interaction of systems and organizations. An examination of the nature of differences in workgroup and individual workstyle, the process of collaborative work, the structure and constitution of group communications, and the process and protocols whereby members of an organization make specific choices of communication channels will provide crucial insights in the design of communication support systems and the organizations which deploy them.

<u>Procedure:</u>

The research described in this report is based on intensive field studies of five distinct workgroups conducted in two sites. The first site was a high technology manufacturing firm, the second a sales and marketing division of a Fortune 500 company. Within the first site, research focused on two engineering teams; sales, marketing and senior management groups comprised the targeted workgroups in the second site.

Field work in both sites was conducted in two distinct phases. The first phase involved selecting the organization to be studied, identifying a range of possible target groups for indepth study, conducting background interviews and informal observations, and developing and field testing data collection instruments and protocols. Whereas the first phase was informal and exploratory, the second phase was more rigorous in method and more finely focused in observation. Participant observation underpinned the multi-method approach. "Shadowing", an observational method involving extended and detailed observation and documentation of the ongoing work activities of sampled subjects provided a unique means to quantify the activities of individual workers, to identify and track a variety of tasks and communications, and to identify channel use throughout an individual's work day.

<u>Findings:</u>

This report provides detailed descriptions of the results and findings of the 3 year project. Focussing on workgroup tasks and communicative interactions, the methodology developed in this study portrays the fine grained, dynamic structure of the workday of members of workgroups. Methods and measures were developed for tracking multiple ongoing tasks of individuals and workgroups. Major tradeoffs were found between the resources individuals need to complete their solitary work and those required to support effective communication and cooperation among workgroup members. A model of individual multitasking is developed and explored

to address these data. The dimensions of temporal and spatial organization and their impact on communication channel choice are examined and discussed in terms of wider issues of individual and group "workstyle". Solitary, cooperative and collaborative modes of work are characterized in relation to the critical tension between accessibility to coworkers and the time needed to complete solitary work. Group work is framed in terms of ongoing "conversations" and the ability of differing communication technologies to support the submergence and reemergence of the threads of those conversations and multiple ongoing tasks.

Utilization of findings:

Findings from this study have direct application for ARI in three key interrelated areas. First, the study should inform the design of communication and information systems. Specifically, the report recommends the development of systems to support multichannel genres of communication and remote access to communication and information technologies. Second, the design of organizations themselves should be examined, informed and adapted, particularly in terms of their ability to support individual multitasking and provide support to users and non-users of existing and developing communication technologies. Finally, the study suggests several ways in which organizational effectiveness can be increased through revising policies and procedures, and developing more effective training models and strategies. Specific recommendations pertain to a focus on the interplay between technology and group architecture and the facilitation of appropriate modes of work.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 Research Problem

With the ever increasing emphasis on information and communication and the continuing evolution of new and powerful technologies to support the dissemination of information, organizations are forced to respond and adapt to these technologies in order to increase or at least maintain their effectiveness. Questions and issues of how to best fit the new and existent technologies to the structures of organizations-- and the structures of organizations to the new technologies--are of critical importance as organizations attempt to fulfill their charters.

Against this background of rapid change, it is necessary to understand fully the interaction of organizations and technologies in order to co-design both systems and organizations which achieve the maximum levels of efficiency. To this end, understanding how and why members of organizations make choices of particular communication channels is crucially important to the design of both communication support systems and the organizations which deploy them. Also important from both theoretical and practical perspectives are questions of how the structures and characteristics of workgroup interaction are adapted, changed and maintained in relation to these communication technologies.

1.2 Research Goals

The goals of the project, as stated in the original proposal, called for analyzing the relationship between communication and decision-making patterns within workgroups. For reasons discussed during the May 1988 In-Process Review and in the 1988 Annual Interim Report, we have broadened the scope to focus on the relationship between communication and the accomplishment of cooperative activities in general within workgroups.

Research in the first field site raised significant questions concerning the observability of decision-making processes within the ongoing stream of behavior. Our experience in the field aligns with that of Mintzberg, Raisinghani and Theoret (1976) and indicates that decision-making activities are most often *not* clearly separable from other work activities. While decisions affecting workgroups were occasionally reached "in public"--according to a structured, routinized process--these occasions were infrequent. The majority of decisions affecting the day-to-day activities of the workgroup seemed to emerge and evolve as part of the ongoing work flow. High level decisions were made out of the view of the workgroup members and the process whereby those decisions were made most often was unknown to members of the affected groups.

Further compounding the problem of the often invisible decision-making process is the tendency of decision makers to recall decisions as having been organized in a more purposeful, sequential and goal-directed manner than they actually were. A further difficulty lies in the inherent incompleteness of archival or transcriptual materials which might be used to elicit the structure of decision making processes (Schwenk 1985). Thus, we found it extremely difficult to trace the structure of decision-making through either direct observation, informant recall or analysis of archival or transcriptual materials. Though potential avenues for the resolution of

some of these difficulties could be suggested, the invisibility issue is less easily bridged. It would appear that the majority of decisions affecting the task accomplishment of workgroups we studied are not behaviorally observable.

The most significant implication of these findings for the present research project is that the research agenda is now framed in terms of relationships between communication and on workgroup or unit performance of cooperative tasks.

An increased understanding of communication, channel choice, and the nature of cooperative work remains a major goal of this study. To achieve this goal, we have focused on work tasks and the ways in which communicative channels facilitate the processing of and movement between tasks. From this perspective, channel choice involves decisions pertaining to an array of communicative choices which allow flexibility and adaptability as workers address work tasks. In addition, we have sought to understand the constraints of the workplace as workers struggle to manage their activities so that they have sufficient time for both solitary and cooperative work. From this point of view, the workplace is much more than a static frame within which work is performed but, rather, it is a dynamic and rich environment where workers make strategic decisions among an array of communicative support tools while addressing a cluster of ongoing tasks.

In general, however, the revised research agenda remained largely the same as the initial one:

> o   Conduct indepth field studies of the communication patterns of selected workgroups in two organizational settings

> o   Broaden the application of linguistic theory to encompass the situationally-patterned behavior individuals display in choosing among alternative communication channels and message features

> o   Test and refine a model (described in detail in the project proposal) of channel choice and behavior which analyzes observed relationships among characteristics of workgroups, communication channels, message structures, and task outcomes

> o   Explore the ramifications of the model for the collaborative work processes of spatially distributed groups

> o   Identify and consider the implications and applications of the research findings and theory for military organizations

1.3 Previous and Related Research[1]

This project has taken as fundamental the premise that to understand the nature of group work and communication style it is necessary to conduct extended, field-based studies involving a multi-method approach to data collection. Though not in anyway a radical perspective in anthropology or sociolinguistics (disciplines which underpin much of the theory for this work), it is an unusual approach in the field of organizational studies. In this section we will place the present study against a

---

[1]   The wider body of research literature, reviewed in detail in Conklin, Schwab and Reder (1988) and updated in an ongoing manner throughout the project, will not be reexamined here.

background of alternative approaches and lay the foundation for a discussion of the field setting.

The field of ecological psychology emerged during the 1940s and provided a new view of human behavior which informed the work of a cadre of researchers. Based on the work of Kurt Lewin (1951) and Roger Barker and Herbert Wright (1949), psychologists began to examine the behavior of individuals and groups in terms of the role played by the environment in enabling and constraining action. Of major significance was the emphasis on documenting the everyday activities of real people involved in real activities. This marked a significant departure from traditional psychological approaches involving controlled laboratory experiments. In the field of anthropology, the work of Edward Hall (1966) on proxemics took the ecological frame into the domain of culture and examined individual and group behaviors in terms of cultural constraints on notions of time and space. Hall's work makes clear that there are widespread and profound cultural differences in the ways in which individuals utilize physical space in their interactions.

Klemmer and Snyder (1972) conducted research on worker communication using a snapshot method whereby observers were deployed to record the activities of workers in offices, laboratories, and hallways at a single worksite. Spending about one hour to cover a single floor of a 24 floor building, the observers entered a work space and immediately logged the activities of the observed workers in terms of a predetermined set of activity categories. These observations provided a means to document the observed workers' own estimations of time spent in the predetermined activities. This approach, while providing blanket coverage of the subjects makes no attempt to place the observed activities into the broader context of daily work. In addition, workers' own interpretations of their activities are not solicited.

Another approach to questions of workgroup interaction and communication comes from the discipline of management studies in the work of Henry Mintzberg (1973). Mintzberg conducted brief field studies of the activities of five high ranking executives in five contrasting settings. Among his conclusions were that managers do not plan, coordinate or control but rather sift and process information and make decisions. Of particular interest was Mintzberg's methodological approach. Some of his methods were similar to those employed in this study. For example, Mintzberg's executives were observed and their activities documented and coded. By recording the chronology of events, classifying them according to "types", and assigning a purpose to these events, he claimed to have captured the essence of the managerial role. As Snyder and Glueck (1980) point out, however, Mintzberg's emphasis on recording individual events meant that he underestimated the purpose of groups of related activities. Further, he relied too heavily on his objective observations and did not conduct interviews with his subjects which could have shed considerable light on their own understandings of the work they were involved in (an omission which is understandable given the fact that he spent only four days with each executive). Clearly, Mintzberg held the magnifying glass too close to his subjects and in doing so missed the larger context within which those discrete events were embedded. As we argue in a subsequent chapter, only by employing a range of complementary methods over an extended period can researchers make sense of the minutia of work activities.

Ethnographic approaches derived from sociology and anthropology by way of the work of Weber (1947) and Parsons (1949) underpin recent approaches to structure and action in the workplace (Willis 1977). Some of the most interesting recent work

in this vein is that of Dubinskas (1988) and Traweek (1988). In field studies of a high technology company and scientific research community, they examine social constructions of time, the ways in which varying interpretations affect the collaboration of technical groups, and the role technologies play in shaping the nature of scientific work. Their work puts forth the argument that there are widespread differences among cultural and even occupational groups (e.g., physicians, business entrepreneurs, nuclear physicists) in the ways in which time is understood and structured in work activities. This research suggests that the careful observation and analysis of space and time utilization in the microstructuring of workgroup activities would be a productive approach for our project.

Sproull (1984) has focused more closely on the work of managers, paying particular attention to the structure of information and task processing. Of particular note is her model of managers as "multi-task processors", wherein several tasks are pending at any one time and attention is shifted from task to task and back again as the work environment demands. This pattern emerged as a key feature of coordinated work in our study.

Most recently, Bowers and Churcher (1989) have undertaken an examination of workplace behaviors derived from the field of discourse analysis. Based on the language/action perspective of Winograd (1986) and speech act theory (Austin 1962) and Searle (1969), Bowers and Churcher have employed discourse analysis to examine the kinds of communication which structure and are structured by work settings. Most importantly, this research highlights the fact that communication is situated in social context wherein meanings are negotiated between actors on an ongoing basis.

Another important approach to workgroup behavior comes from the work of technology developers and impresarios. Bullen and Johansen (1988), in a critical review of emerging commercial trends in groupware technology, point out that evolving commercial groupware products may be categorized according to whether they are designed to support groups which are (1) dispersed vs. non-dispersed in physical space and (2) interacting synchronously vs. asynchronously. Such a classification scheme is relevant to our approach in that it clearly recognizes the predominant role of spatial and temporal factors in designing technologies for computer supported cooperative work.

A final source comes from our own informal observations of some profound occupational and suboccupational differences in the ways in which workgroups share space and structure activities in their work environment. Without providing details at this point, we observe that some occupational groups, such as artists, architects and mechanical engineers (who commonly design physical objects whose development is typically shared in posted drawings or sketches), tend to prefer open workspaces through which colleagues are encouraged to browse. Other occupational groups (e.g., software engineers, academics, writers) tend to prefer more enclosed and private workspaces which offer fewer intrusions and unscheduled interruptions. As we develop this report, a theoretical framework will emerge in which the nature of work, the characteristics of the physical environment, the temporal structuring of time and workgroup interaction patterns are seen to be closely related.

Our interest in channel choice and channel switching behavior is grounded in a body of research which focused on the differential effects of using alternative communication channels (Short, Williams and Christie 1976, Williams 1977 and

1978, Fowler and Wackelbarth 1980, Heimstra 1982, Rice 1984). Other trends in this vein of research have focused on differences among alternate channels in terms of "social presence" (Short, Williams and Christie 1976) or "richness" (Bodensteiner 1970, Daft and Lengel 1983). Social presence refers to the degree to which communications through a particular channel carry social communicative cues, while richness refers to the extent to which communications convey cues, provide ongoing feedback, reduce ambiguity and the like. Much of this research on channels and their communicative characteristics focuses on the appropriateness of certain channels for certain tasks (Short, Williams and Christie 1976). Our approach in this study, however, has been to focus on how a mix of accessible communication channels in the workplace provide flexibility and adaptability for collaborative work. As we will see in later sections, the appropriateness of a channel for a communicative task is less significant than the availability of a cluster of channels to facilitate multiple tasks and multiple interactants. It is this orchestration of communication through a rich array of channels which enables the cooperative aspects of group work that increasingly underpin tasks in the workplace of today.

1.4 Evolution of Methodology and Site Selection

The research methods and theoretical model developed in this study are based on what Glaser and Strauss (1967) refer to as "grounded theory". Though no direct comparison of the data across the two sites were planned, findings pertaining to workgroup communication and cooperative work were continually analyzed and compared and a theoretical model refined. Significantly, this approach allowed the synthesis of two distinct field studies by a continual, focused examination of differences and similarities of patterns of data between the sites.

From the onset, the focus of this project has been on conducting naturalistic research. Consequently, the requirements for suitable research settings were defined very early in the project. First, the field settings were to be ones in which the management were agreeable to the proposal research. Thus it was necessary that the management in both sites allowed access to workers and the activities of workgroups over an extended period of time. This requirement may seem minimal, but in fact, given the intensive observational nature of the study, it required a major commitment on the part of management and workers in both sites.

The study also required access to workers and workgroups in settings which were communication intensive, where workers had access to a range of communication technologies, and where coordination and collaboration were significant aspects of the work process. Consequently, a group of accountants working independently on separate accounts would have been a poor choice in terms of the requirements of this study.

In addition, a major focus of the research was on the coordination and collaboration of members of workgroups which were spatially dispersed. In the first site, workgroup members were distributed within a building whereas in the second site one of the studied groups was dispersed among cities thousands of miles apart while another group was based in a single location but dispersed by frequent travel.

Finally, the research interests in selection of communication channels required that the studied sites and workgroups utilize a rich array of communication technologies. These technologies should include not only the traditional repertoire of face-to-face conversation, telephoning and written communication, but also regular use of newer

and emerging technologies such as electronic mail, facsimile transfer and so forth. The selected sites differed in their repertoire of communication technologies used. For example, facsimile transfer was effectively absent in the first site but was a critical communication channel in the second. Electronic mail, on the other hand, was a key channel in the first site but little used in the second.

1.5 Organization of Report

The remainder of this report is organized into 10 additional chapters. Chapter 2 describes the settings for the research conducted in the two sites. Within this section are descriptions of the companies and workgroups studied, and communication technologies present in each site. Research methodology is presented in Chapter 3, which includes a discussion of data collection techniques and instruments, and a description of the structure of fieldwork in the two sites. Research findings are presented in chapters four through nine. Chapters 4 and 5 report qualitative and quantitative results from the first field site, respectively. Qualitative and quantitative results from the second site are presented in chapters 6 and 7[2]. The two sites are compared and contrasted in Chapter 8. Because of refinements in data collection methods and project focus, some of the quantitative data collected in the second field site were not comparable to those of the first site. These data are presented and discussed in Chapter 9. Theoretical conclusions of the study are presented in Chapter 10. The report concludes with a discussion of research findings and applications for the Army Research Institute in Chapter 11.

Figures and tables appearing in this report have been numbered sequentially within each chapter. For example, the first figure appearing in Chapter 5 is numbered figure 5.1. The sequences of figures in Chapters 5 and 7 are parallel in order to facilitate comparisons between the data sets for the two sites. The raw data corresponding to the figures in Chapters 5, 7 and 9 appear in Appendices A, B and C.

---

2   For purposes of clarity, the structure of presentation of the data are similar for each site. Accordingly, there is some minor degree of redundancy in the two sets of chapters.

2.0 FIELD SETTINGS

In this chapter we present overviews of the two field settings. We will broadly sketch the nature of the companies and targeted workgroups, the work environment and the communicative and work styles of the groups. A key dimension of contrast between the two sites pertains to the nature of work in which the various groups were involved. In the first site the research focused on two product development teams engaged in developing specific products. These groups comprised individuals who were selected and assigned to work together on two projects. In contrast, research in the second site focused on three groups which were established organizational entities responsible for a range of tasks.

2.1 Site 1: The Company

Io Products Corporation (IPC)[1] is a multi-site manufacturing firm. IPC's product line is extremely broad, serving customers in business, industry, research and development centers, corporations and a wide range of institutions. Equipment manufactured by IPC ranges from fairly small machinery and tools to complex equipment configurations that constitute basic systems for their customers. It is an established company with a national and international customer base, well respected locally and across its industry. Io Products has long standing relationships with many of its major customers and places a high priority on marketing to and sustaining these accounts.

IPC prides itself on its cooperative and supportive work environment. It has many career employees, tries to promote from within, and offers generous compensation to retired and laid-off workers. In return, the company enjoys a high level of loyalty from employees at all levels. The management style is described -- by managerial, professional, technical, and support personnel alike -- as friendly, open, and casual. IPC attempts to keep its employees apprised of and invested in company policy and direction through meetings and information dissemination, through accessibility of all levels of management to staff, and through direct incentives such as profit-sharing.

To foster this sense of community and to enhance the company's ability to retain flexibility in meeting the changing demands of its marketplace, IPC has recently reorganized itself into operating divisions that are intended to function as "companies within a company." A division has not only its own product development and manufacturing departments, but also dedicated marketing, finance, and personnel staff. A division chief reports directly to a vice president. Divisions are expected to be profit-making units. Thus, division heads function somewhat in the manner of executive officers, responsible for assuring that their divisions are contributing to the profitability of the company even when they have research and development missions.

2.1.1 The New Products Division. The New Products Division (NPD), a division of IPC, employs over 600 workers. The division is responsible for design, development, manufacture, and marketing of a range of high technology products. Two sets of activities within NPD were targeted for detailed study: the Nova and Mars projects (Figure 2.1).

---

[1] Pseudonyms are used for this and all other organizational and personal names throughout this report.

New Products Division Targeted Workgroups

Manager,
NPD Computing

Secretary

**Manager,
Software Utilities**

Utilities Engineer

Utilities Engineer

Utilities Engineer

Utilities Engineer *

Utilities Engineer *

**Manager,
Software**

Program Manager,
Networks

MARS Team Lead Engineer

Network Engineer

Network Engineer

Operating System Engineer

Operating System Engineer

Operating System Engineer

**Manager,
Mechanical**

Mechanical
Engineer

**Manager,
Hardware**

Development Engineer

Development Engineer

Development Engineer

Development Engineer

Development Engineer

Development Engineer

**Manager,
Testing & Sustaining**

Hardware Sustaining Engineer

Hardware Sustaining Engineer *

Software Sustaining Engineer

Prototype Technician

**Program Manager,
NOVA**

NOVA
Integration
Team

MARS
Component
Team

* Individuals *not* targeted for study.

Figure 2.1   New Products Division Targeted Workgroups

The New Products Division is housed in two adjacent buildings of a multibuilding complex 30 miles away from the company headquarters. It takes 5 to 10 minutes to walk the length of the two buildings. The buildings share an entry and reception area, cafeteria, and a group of meeting rooms. All visitors must enter the secured buildings via the reception area, where ID badges are issued. Employees may enter and exit through a number of doors, using their required electronic photo badges for access.

All NPD employees, including the Division Chief, are housed in open office cubicles. Company policy encourages accessibility of managers and this is represented and, in part, achieved through their physical availability. Even senior managers have cubicles and they can be readily observed--as being in- or out-of-office, alone or in conference, on the telephone or on the computer--by passersby. Only the most senior managers have secretaries who do some screening of "visitors", but supervisees frequently lean over the cubicle wall and chat. Generally, managers are situated in easily accessible cubicles, near the central aisle or the outside aisle while most team leaders are located among the workers they supervise.

NPD employees also work with individuals outside of their division. They may travel to, or otherwise contact, coworkers at the other complexes of IPC. There are field staff who come to work at NPD, or other individuals who may be assigned to assist. Further, many NPD employees--technical staff as well as managers--have regular communication with counterparts in other corporations. These may be vendors of components of NPD products or customers of the company. Although travel is a component of some workers' jobs, telecommunication is far more frequent among members of the NPD workgroups studied in this project.

2.1.1.1 Nova Integration Group. The Nova project was a high profile project within NPD and was watched carefully by IPC's corporate offices. The project involved a Divisional effort to design, build and market a new, strategic, top-of-the-line product which would establish IPC as a serious contender in an expanding but highly competitive market segment. Success in this endeavor required the participation and support of almost every level and department of NPD, and expectations and commitment were correspondingly high. The Nova group was comprised of technical specialists from many different segments of the Division. The size of this group fluctuated over the span of the project, expanding and contracting during different phases of the design and engineering effort. In addition, NPD employed a matrix management model whereby workers from multiple staff units could be assigned to given projects. In this system a given worker could be working on more than one project at a time. In order to focus our research efforts, an operational definition of workgroup membership was used: for the purposes of the study, Nova group members were defined as those individuals spending 50% or more of their time on that project. Using the .50 level of effort as the criterion, 16 individuals were identified as members of the Nova group, and 13 of these individuals were targeted for study.

2.1.1.2 The Mars Component Group. The Mars project was a low profile project in comparison to Nova. The task was to adapt an emerging industry standard component to existing NPD products; the medium term outcome was to upgrade an existing in-house product. Though strategically important, the work was considered much more straightforward, and thus, in the words of one Mars group member, "not as glamorous" as the immense task of designing and integrating a product like Nova. In addition, there was a high degree of anger and resentment among some NPD

9

staff that "management" had decided to abandon the locally developed component and replace it with the Mars component.

The Mars group targeted for indepth study operationally composed of 7 individuals. As with the Nova group, the core group was defined as comprised of individuals who spent 50% or more of their time on that project.

2.1.2 Communication Technologies and Use by Groups.

During the course of the study, an inventory of communication technologies was conducted in NPD. As can be seen, there was a wide array of technologies available to workers in NPD. Individuals made choices on a day to day basis from among these options in the course of completing their work. The discussions of channel choice, workstyle and workgroup communication which appear in later chapter will be thus placed against this backdrop of available technologies.

computer terminals and workstations:

> Each group member had in his or her work area a terminal(s) connected to a work station(s) and/or a terminal connected to one of the NPD or IPC mainframe computers. Each person had a terminal connected to a local area network over which file sharing and electronic mail was available. Members of the groups under study were thus linked through a computer network. This network also provided access to in-house and external electronic bulletin boards and wider communication with coworkers and colleagues across sites, nationally and internationally. Many of the group members had computers at home which enabled them to dial in to the workplace systems and work remotely. Workers could thus run or monitor test suites, develop software, send and read electronic mail, or prepare status reports from home.

> Electronic mail (hereafter termed "email") was the critical communication channel for almost all members of the groups studied. The Unix based email system allows users to customize the operation of the email system, enabling them to, for example, share files and messages with selected groups of coworkers; be notified when new mail has arrived, or, alternatively, ignore incoming email; set specific time intervals at which new mail is searched for; and use automatic forward, carbon copy, and blind copy features. At logon, the computer system automatically notifies users whether email or "news" (the company bulletin board) has been received since logout. Some important notices for users, such as scheduled machine shutdowns, are stated in full at logon.

> There were also a limited number of Macintosh and MS-DOS computers in NPD though none of the Nova or Mars group members had such machines in their work areas. The rare occasions when members of the study groups used such non-Unix machines involved the use of specialized software not available on the mainframes or workstations, e.g., project management software for charting project timelines.

printers:

> A bank of dot matrix line printers were housed in a central location and all print jobs could be sent to these machines over the local area network. In addition, there was a single high quality laser printer for letters and other

documents requiring higher quality production. None of the Nova or Mars group members had their own printers.

photocopiers:

Several photocopy machines with varying capabilities were located throughout the building. Among the copiers were capabilities to reduce, enlarge and collate pages. For the most part these machines were used more often by support staff than engineering staff.

telephone:

Telephones were provided in each work cubicle in NPD. Telephone lines are direct dial, but employees can also be reached via a NPD receptionist who directs the calls to the appropriate recipient.

Though rarely used by anyone other than managers, the telephones could be forwarded to secretaries. In addition, callers within NPD can use a call-back feature which lights a button on the called party's phone and redials the caller's number when a code is punched. This feature is used by some employees.

The telephone is used almost exclusively for one-on-one interaction. While the telephones have a conference call facility, multi-party interactions via telephone were not observed in NPD. Similarly, conference rooms were not regularly equipped with telephones and speakerphone conference calls were not observed among the groups studied.

hard copy document transfer:

Four modes of document transfer were observed at NPD: hand delivery, internal IPD mail, regular US Postal Service, and overnight courier mail. Facsimile transfer was available though never observed over the several months of field observation.

calendars:

A range of options was employed by workers in the Nova and Mars teams. Nearly all kept a standard "daytimer" style calendar in which meetings and appointments were scheduled, but for many of the workers the calendar served as a medium for recording additional information. Meeting notes, "to do" lists and records of activities are often kept in these portable calendars. In addition, since most of the group members were sophisticated users of computing systems, there was a high rate of use of electronic calendar programs. These systems, for example, provided reminders of the day's meetings, events, tasks, and appointments at login.

Scheduling of activities which would affect coworkers is announced informally through face-to-face interaction, during groups status meetings, or more formally by way of electronic mail or hardcopy memos.

overhead projectors:

Overhead projectors were available in the larger conference rooms and tended to be used to display information during formal presentations. Project status meetings and various impromptu or ad hoc assemblies tended not to use projectors.

chalkboards/whiteboards:

NPD's conference rooms are all equipped with blackboards and/or whiteboards. Some of the latter are electronic boards having immediate hard copy reproduction capability. Some individuals have small white boards in their work cubicles. Larger whiteboards are attached to walls in common areas of some sections; they are used to display timelines and project plans for the group.

Interestingly, displays on blackboards and whiteboards located in meeting rooms are considered potential sources for breaches of company security and are required by company policy to be erased at the time the meeting adjourns.

travel:

Among the groups studied in NPD, travel was not usually an integral feature of workgroup activity. The manager of the Nova integration effort was the singular exception to this pattern. Though many of the members of both the Nova and Mars workgroups had need for communication with colleagues in remote sites, nearly all of this communication was carried out through electronic mail. As manager of a complex project which depended on a close engineering alliance between NPD and a supplier of a critical component, the Nova group leader traveled interstate several days each month.

video technologies:

A range of technologies for video communication are available to employees of NPD though none are used with significant frequency. IPC has its own closed circuit television system and annual addresses from the CEO, major announcements and employee/management question and answer sessions are carried over this medium. During such special events a television monitor is set up in the NPD auditorium. Professional development courses in a variety of subjects are available by way of a satellite down-link to a classroom on the NPD campus. Such courses are provided by a private vendor and tuition fees are paid for those IPC employees who participate. The system used for this training was one-way, non-interactive instruction. Video tape was used on rare occasions, usually to preview a new advertisement campaign or to view offerings from vendors. A cart with a video player and monitor was moved to whatever location was suitable for the viewing.

Public Address System:

The audio public address system (PA) is a minor, but noteworthy, communication channel. The PA system was used to announce computer system shutdowns and crashes, page individuals for critical telephone calls,

announce the commencement of divisional assemblies, and to relay important company news (such as the quarterly profit-share).

2.2 Site 2: The Company

Parallax Corporation is a Fortune 500 company providing a range of goods and services throughout numerous States covering a territory which includes three time zones. Recently reorganized, the company had a tradition as conservative, dependable and stable. To keep pace with the accelerating rate of change in the industry, Parallax has made drastic changes in its structure and redefined its approach to the marketplace. The business market was reassessed and the traditional way of doing business was scrapped. The newly restructured Parallax Corporation is composed of relatively autonomous Divisions which are developing aggressive strategies to pursue customers and expand traditional markets.

Parallax has long stressed the importance of keeping its workforce informed and uses a range of communicational tools including television, video, and print materials to that end. Staff development activities are varied and encouraged and a range of committees and programs involve and support many special interest groups within the company. Though there is no profit-sharing per se, many if not most Parallax employees own stock in the company and feel deeply committed to the continued success of the corporation.

2.2.1 Convex Systems Division (CSD).
The Convex Systems Division (CSD) was formed in 1987 to serve a specialized market segment. As part of Parallax's new vision and corporate reorganization, CSD was formed to focus on a market segment traditionally served by several different divisions. With over 500 employees, CSD serves customers located throughout the whole of Parallax's multi-state region. The Division's Northwest headquarters house approximately 100 of these employees with the balance of staff dispersed among field offices throughout the region.

Morale is generally high in CSD and workers see themselves as breaking new ground for Parallax. Management has worked hard at and has largely succeeded in instilling a sense of common goals among workers in CSD. Still, like many corporations in the late 1980s, Parallax has been forced to make its workforce lean and competitive. The aggressive pace of change and market oriented management style has been difficult for some Parallax employees who bemoan the loss of "the good old days."

After several weeks of preliminary discussion and observation, three workgroups were selected as target groups for the study: CSD Senior Management, Sales Development and Marketing (figure 2.2). In the sections which follow, the structure of the target groups, their functions, physical distribution, and the nature of their work will be sketched and contrasted.

2.2.1.1 CSD Senior Management Group.
The Senior Management group is composed of nine individuals including the heads of the Sales, Marketing, Human Resources, Finance, and Legal sections. It is at the level of the Senior Management group that key decisions affecting the Division are made. All spend time attending to the operation of the Division, but with the exception of the Vice President and General Manager who heads the Division, Senior Management group members spend most of their time on the daily operation of their own sections. Thus the

Convex Systems Division Targeted Workgroups

Vice President and General Manager *
Convex Systems Division

Executive Secretary (1)

Manager, Division Strategy * (1)

Director,
Finance & Strategy *
(1)

Director,
Human Resources *
(1)

Vice President,
Marketing *
(1)

Secretary (1)

Director,
Development (1)

Director,
Planning (1)

Director,
Systems (1)

Director,
Product Management (1)

Manager, Ongoing Product Management (1)

Manager, Product A Marketing (4)

Manager, Product B Marketing (4)

Manager, Product C Marketing (1)

Manager, Product D Marketing * (1)

Manager * (1)

Manager * (1)

President,
Optikos Systems, Inc.
(3)

Vice President,
Sales
(1)

Secretary (1)

Director,
Service (1)

Director, Sales
Region A (6)

Director, Sales
Region B (2)

Director, Sales
Region C (5)

Director, Sales
Region D (7)

Sales Manager,
Sales Development (5)

Project Manager (6)

Project Manager * (4)

Project Manager * (2)

Project Manager (5)

Project Manager * (6)

Project Manager (2)

Project Manager (5)

Senior Technical Consultant * (2)

Chief Counsel,
Legal
(1)

Senior Management Team	
Marketing Group	
Sales Development Group	

* Individuals Targeted for Study

1 - Headquarters
2 - Field Office 2
3 - Field Office 3
4 - Field Office 4
5 - Field Office 5
6 - Field Office 6
7 - Field Office 7

Figure 2.2   Convex Systems Division Targeted Workgroups

workgroup members are relatively autonomous in carrying out many of their activities.

2.2.2.2 CSD Sales Development Group. The Sales Development group is unique to the Division and consisted--during the period of study--of eight individuals dispersed among five cities and three time zones. The role of the Sales Development group is to support sales of targeted products or services. The Sales Development group has no home base, and members are distributed throughout the region in sales offices among regular sales staff. Though closely involved with the regional sales staff on a day-to-day basis, they interact frequently and report to a single manager who reports directly to the Vice President of Sales.

2.2.2.3 CSD Marketing Group. The Marketing group targeted in this study is composed of three members, all located in the Division headquarters. The group is one of three newly formed parallel groups charged with developing applications for new and existing products. The nature of their work requires very infrequent travel. The group is stratified with two product managers reporting to one mid-level manager who in turn reports to the Vice President of Marketing. Though the group supervisor's role involves overseeing the activities of the group, the group functions on a day-to-day level very much as a group of peers. Though the Division as a whole is ultimately geared to the sale of products and services, this group's concern is focused on designing applications for the products and services themselves.

2.2.2.4 CSD Communication Technologies and Use by Groups. Early in the study, an inventory of communication technologies was conducted at Parallax headquarters. Inventories of the remote sites were carried out once those sites were identified. These inventories clearly suggest that the individual members of the workgroups targeted in this study had access to a wide range of communication technologies. In most ways the workplace environment was rich in terms of communication options and choices, but field observations indicate that such accessibility implies neither efficiency of use nor even use at all. The dimensions of use and efficiency are related to not only the availability or accessibility of communication technologies, but also to issues of personal, workgroup and corporate communication style. Style is a critical variable which must be considered when attempting to make sense of patterns of workgroup communication, but to move toward an understanding of why particular communication choices are made it is necessary to first portray the communicative ecology of the targeted work sites. In the remainder of this section we will examine the available technologies, contrasting their inherent capabilities with their actual use. This discussion will set the stage for a later examination of group communication genres, channels, and communicative style.

personal computers:

> The Vice President and General Manager of CSD is widely credited with making an early commitment to a standardized desktop computing technology. Accordingly, the CSD goal of an Apple Macintosh on every desk has been largely realized. Among the workers in the groups studied, these computers were used most for word processing and to a lesser extent for spreadsheet applications. At each location these computers are connected by a local area network. Although facile connections between locations can be made in principle through the various Parallax mainframe computers operated by Parallax Data Resources, a separate division of Parallax Corporation, this capability was rarely used. Though the networking

software enables file sharing within a local area network, this capability was employed by an insignificant fraction of workers. Electronic mail was available through modem connections to Parallax mainframes, but use of this capability was apparently difficult and rarely observed. Additional software was being installed to allow file transfer between CSD locations by modem, but this software was not yet in place during the time of the study.

laser printers:

The Apple Macintosh computers were capable of sending files to centrally located laser printers across the network at each location. These printers provided very clean, crisp copy in a variety of typefaces and sizes, and were heavily used by all workers.

mainframe terminals:

Some workers in CSD access a variety of databases maintained on mainframe computers using terminals located on site. No one in the targeted groups, however, had need for direct access to these terminals. Financial information, for example, when required by one of the members of the Senior Management group for use by others is accessed by special staff who then prepare printouts or summaries.

photocopiers:

Each site contained at least one photocopy machine. These machines were readily accessible and provided quick, high quality copies.

typewriters:

None of the workers in targeted workgroups had typewriters in their work areas. Typing appears to be accomplished entirely through word processing.

telephone:

Telephones are clearly the key communication technology for workers studied at Parallax, both for communications between pairs of individuals and among groups making conference calls. With the exception of one individual, all studied workers had telephones on their desks which offered a wide range of special features. The single exception was a worker temporarily seated at a desk with a standard telephone without special features.

Telephones were frequently used to communicate with colleagues in distant locations, local offices and sometimes with those seated only a few yards away. Conference calls, connecting a number of individuals in various locations, were a common form of workgroup communication. Individuals could participate in a telephone call using the speaker phone feature. In practice, however, workers rarely used the speaker if they did not have private offices.

In addition, cellular car phones became available to some of the Senior Management group toward the end of the study.

hard copy document transfer:

> Five modes of hard copy transfer technology were used by CSD workers: hand delivery, internal Parallax mail, US Postal Service, overnight courier mail and facsimile. The majority of observed document transfers involved hand delivery between coworkers, accounting for about 67% of all document transfers.

voice mail:

> Among the groups studied, voice mail capability was limited to members of the Senior Management group. During the course of the study, however, members of this group were never observed to access voice mail boxes. This is not to suggest, however, that they are never used. Interviews with members of the Senior Management group indicate, for example, that one individual used the voice mail system to relay information to an executive secretary when out of town.

calendars:

> All of the individuals participating in the study used some form of personal calendar system. Schedules for members of the Sales Development and Marketing groups were communicated verbally and occasionally by hardcopy or electronic mail. Most members of the Senior Management Group, the only group with personal secretarial support, maintained two calendars. The first was a personal copy, the second was kept by the executive secretary.

overhead projectors:

> The formal presentation is a key genre of communication in CSD and an overhead projector is a crucial tool for their presentations. Meeting rooms are all equipped with projectors. Recently, a new mode of overhead projection appeared in CSD; any Macintosh computer can be interfaced to a special device which can be placed on top of a standard overhead projector to project computer screens onto the overhead projector screen.

chartpaks:

> Chartpaks were the preferred technology for capturing information generated by a group during a scheduled meeting. Where group process was a prominent feature of the meeting, chartpaks were almost invariably a part of the meeting. As such meetings progressed, the walls and sometimes the windows were covered with sheets of paper from the chartpak.

whiteboard:

> Whiteboards were not a prominent communication medium among the workgroups studied in CSD. The two major presentation rooms in the Parallax Headquarters both had whiteboards but they were contained within cabinets and never observed in use. Similarly, whiteboards were not used by Sales Development group members during observations in the remote locations.

video conferencing access:

> Video conferencing is rare among workers in CSD. Though facilities are available near the Parallax Headquarters, these facilities were never used by any of the workgroups studied during the period of data collection.

personal travel:

> Travel is often unrecognized as a communication technology. For much of the work of the Senior Management and Sales Development groups travel is often the most effective way to interact with customers and dispersed staff. Travel, however, was limited by budgetary considerations, especially toward the end of the fiscal year when travel restrictions were put into effect. When this happened alternative communication strategies were required and implemented.

video cassette recorder/monitor:

> Video cassettes represent a communication medium which is increasing in prominence within CSD. A daily in-house news and corporate information program, *Parallax View*, is shown directly through closed-circuit transmission to the major office locations and then by videotape in smaller offices. At the time of the study, CSD in the Parallax Headquarters building did not have equipment for reception of the closed-circuit broadcasts. Videotape is also becoming a significant mechanism for communicating new products and services not just to customers but to other CSD and Parallax employees.

Human communication mediators:

> It was not uncommon at CSD for managers to send a subordinate to a meeting as a substitute. Though the practice was well established, most workers complained that it tended to delay the work process since substitutes were rarely given the authority to act in the place of the person they represented. For many managers, using substitutes was a strategy to avoid what they perceived to be an overuse of meetings.
>
> For members of the Senior Management group, secretaries frequently acted as mediators, screening calls and visitors, sorting mail and ensuring that an orderly flow of information continued. This was especially important when the Senior Management group members were dispersed by travel.
>
> Another type of human communication mediator was the meeting facilitator. These individuals were called in to assist with special types of meetings, usually involving goal setting, team building and the like. these facilitators were not CSD employees, and while they sometimes came to know specific groups through ongoing interactions, they were clearly outsiders.

In this chapter overviews of the two field settings have been provided and the structures of the targeted workgroups in each site described. In addition, a sketch of the communicative technologies available for workers in each site has been provided. In the chapter which follows, we will focus on the methods and instruments used in the collection of data in the two field sites.

3.0 METHODOLOGY

3.1 Multi-Method Approach

In contrast to laboratory based studies which begin with the premise that behavioral experiments can be designed, variables controlled and the target phenomena measured and remeasured, this study attempts to examine behavior as it unfolded in the context of the natural setting. The methodological implications for studies beginning from such different starting points are significant. In the former, hardware and physical instruments are designed and the experimental setting controlled by the researcher in order to manipulate and measure the phenomena under study. In the latter, the researcher is the principal research instrument, and the methods and instruments employed in the study of the phenomena in question provide alternative frames for objectifying and recording the observations of the researcher.

The research approach taken in this study was largely ethnographic and involved, in part, an attempt to uncover and document the cultural knowledge of "natives", to understand their work from their points of view. This involved trying to reach some understanding of the nature of group work and the use of communication and information technologies among targeted workgroups in real settings as they carried out real tasks. This is by no means a simple endeavor. Although informants can answer questions if framed in terms and concepts which make sense to them, and observers can recognize patterns of behavior if they know how, where and when to look, these are not skills which can be developed or applied over a few days or even weeks in the field. An extended period in the field by trained observers is absolutely essential for the success of the study. While it would have been possible to construct an experiment wherein workers were brought together, provided a series of communication and information system technologies, given a range of carefully constructed tasks and had their behavior measured and documented, the results would not likely reflect the complex system of meanings, rules of behavior, or the hidden dimensions of custom which underpin the situated behaviors of workers in their workplaces.

At the same time, even the most exacting and detailed description of the "native point of view" will be found lacking if divorced from the context of observed behavior. Thus it is critical that a systematic approach to observing and recording the actions and interactions of the subjects of the study be employed. Without a rigorous and balanced approach the research is incomplete.

Methodologies employed in naturalistic, non-experimental settings need to be flexible and adaptable to the unique contingencies of the field setting. In addition, the researchers need to have at their disposal a range of instruments in order to expand their abilities to gather objective data. Thus the methodological design of this project involved an emphasis on the collection of two different types of data. While there was always an attempt to collect quantitative data, research methods yielding qualitative data were also employed to ensure that quantitative data would remain linked to the social context of the research setting. To this end, there was an equal emphasis placed on the careful collection of qualitative data. This quantitative-qualitative mix is critical to the approach taken in this project since in combination they result in a quality of data which goes far beyond the sum of the two parts. The qualitative data provide a frame and context for the quantitative

observations and at the same time provide an anchor for the perceptions and interpretations of the researcher. The two modes of data collection are in this sense complementary yet they are not derived from the same--and in fact require quite different--methodological tools. The sections which follow provide discussion, examples and definitions of data collection methods employed in this study.

3.1.1 Participant observation. The degree to which it is possible to actually participate in the ongoing activities of the field site is highly variable across settings, but the goal remains the same: to spend extended periods of time in the field among the subjects in order to observe and understand the patterns of daily activities. Ideally, the researcher is accepted into the setting over time and--though it is never the case that his or her presence goes unnoticed--the subjects of the study become increasingly less self-conscious and the researcher begins to experience the rhythms of life in the field setting and to gain insights into the workings of what was initially an unfamiliar scene.

Participant observation is one of the cornerstones of the multi-method approach taken in this study because it enables the researcher to observe and follow both foreground and background activity in the field site. Though sometimes focused on a particular activity, participant observation often allows relatively informal observational "scanning" on an ongoing basis.

The traditional analogy used to describe the method of participant observation in anthropology is the "fieldworker as infant". On entering the field site for the first time and for periods thereafter, the researcher has to learn everything from the ground up, beginning with the language, just as does an infant. In every case, the assistance of the subjects is required for an understanding of even the most basic rules, principles and patterns. This is not only the point of view of the outsider who feels virtually dependent on the hosts, but also the hosts who tend to view the researcher as pathetically ill-prepared to understand the basic operations of the community, let alone the fine, subtle points. Though not as extreme, this basic pattern held true for the research conducted in both field sites.

To whatever degree possible, the researcher is involved with the daily activity of the subjects while conducting participant observation. We were given an office, electronic mail accounts, a computer and other accoutrements of the office. We were issued security passes and could come and go from secure areas as we pleased. We spent full working days with the subjects and attended meetings and staff retreats as well. Over time, we came to "fit in" with the other workers and became a part of the work environment.[1] But participant observation involves much more than just "hanging around". Research by participation is anchored in a careful recording of the activities observed, and it is this distinction which separates participant observation as a research method from the musings of the casual observer. In order to interpret and understand an activity or clusters of patterned behavior, it is necessary to be more than a casual observer.

3.1.2 Fieldnotes. In this study each of the researchers kept written notes on people, activities, behaviors and details of the work environment. These field notes are as much a physical record of the individual researcher's observations, insights, and interpretive penetrations of the world of the research subjects as they are a

---

1   Because we worked with a small sample of workers in both field sites there were many employees to whom we were never introduced. Though formal memos announced our presence at the beginning of the project, many people we passed every day never realized we were anything other than employees of the specific companies.

methodological process. During the whole of the project, the researchers continually reexamined their fieldnotes to put more and more pieces of the puzzle of behavior together. In this sense observations which seemed unrelated to the larger sequence of activities at one point in time often emerged as part of a significant pattern later.

3.1.3 Interviews. At the beginning of each field study, formal interviews were conducted with a wide range of workers. These interviews focused on communication and workstyle patterns and preferences. In addition, because the study focussed in part on dispersed workgroups a range of workers belonging to such groups was interviewed. Because the cost of face-to-face interviews with these workers during the exploratory phase of the project would have been prohibitive, telephone interviews were conducted with individuals at remote sites. Though not as rich as the face-to-face interview (where the physical setting can be observed by the interviewer), the telephone interviews provided crucial initial information.

Once the target groups had been identified, more indepth interviews were carried out with each of the prospective subjects to obtain additional background information and individual agreements to participate in the ensuing structured study. As the study progressed, more informal interviews were linked to participant observations and became an ongoing feature of the data collection process.

3.1.4 Shadowing. A cornerstone of the multi-method approach used in the field studies was a structured observation methodology termed *shadowing*. Individual members of targeted workgroups were, on a random schedule, followed ("shadowed") and closely observed for entire working days. While shadowing a worker for a day, the researcher would sit inobtrusively in the worker's office while he or she conducted their work, participate in meetings held in the office, accompany the worker as he or she walked around the facilities, visited other workers, participated in meetings held elsewhere, and so forth.

These shadowing days served as the common context for a number of interrelated data collection methods: unstructured participant observation, structured shadow observation, electronic and hardcopy document collection, and audio recordings of conversations and meetings. Details of these data collection activities are described below.

The structured shadow observation methodology employed in this study involved extended and detailed observation and documentation of the work and communication activities of individuals within targeted workgroups. The goal was to understand how the members of these groups accomplished their work and how the work activities themselves were accomplished through communication, coordination and collaboration over a period of days, weeks or months[2]. This methodology provided a unique means to quantify the daily activities of individual

---

2   There is always the possibility that the presence of observers influences the character of the subject's workday. For example, it is possible there is some degree of increased efficiency when an observer is present. On the other hand it is possible that the observer distracts the subject and the opposite effect is produced. One control over such influences is to ensure that the observation is not "cold". It is important that the subject knows the observer and fully understands the purpose of the research, i.e., the research is not intended to be an evaluation of the performance of the subject.

The observations were carefully structured to be minimally intrusive and care was taken to get to know and become familiar to the subjects selected for the shadowing sessions. In light of the extended nature of the fieldwork and the

workers, and to identify and track a variety of tasks, communications, and patterns of channel use throughout an individual's work day. In order for this quantification of behavior to be meaningful, it was critical that the analysis of patterns of behavior revealed by the structured shadow observation instrument be informed by qualitative data. Counts and durations of occurrence of specific behaviors, for example, needed to be placed in the context of action and meaning. Only through a mix of complementary research methods linking observed behaviors to meanings and understandings of the subjects were the data interpretable.

The shadow observation techniques developed in this project are derived from the classic studies of the ecological psychologists Roger Barker and Herbert Wright (1951, 1955). Barker and Wright's patterned observations were used to document and describe "a day in the life of" a variety of social and institutional settings, tracing out what he termed the basic "stream of behavior" characteristic of a particular social environment. Lee Sproull (1981, 1984) elaborated some of Barker and Wright's methods for use in the quantitative study of the workplace. The structured observational methodology developed and used here represents a considerable refinement and specialization of the techniques to the issues of workgroup communication and cooperation.

Observations of work patterns and communicative activities were documented during shadowing sessions with structured observation instruments developed for this project. In each of the two sites, instruments were piloted and revised several times. The final versions adapted for each site reflected this process of refinement and testing as well the need to collect information pertaining to the specific features of the communicative contexts of the different sites. Though the final instruments for each site were similar, there were some significant differences. The following sections present: the instrument and data collection protocols used in Site 1; the differences in the instrument and protocols used in site 2.[3]; and a detailed example to illustrate the implementation of the coding protocols in the observation of workplace behavior.

3.1.4.1 Shadow Observation Instrumentation: Site 1.

Please refer to Figure 3.1 during the following description of the instrument. The first column, "Start", marks the beginning of an observed activity. The start time for the subsequent activity provides the end time for the previous entry. The next column, if marked by a "C", indicates that the activity is a continuation of an earlier activity which was interrupted by someone or something outside the subject's control. A blank space in this column indicates the code was not applicable.

The "Tape #/footage" column is used to identify tapes and to locate the recorded interactions on tape. For example, "20/a 155" designates tape 20, Side A at the 155 foot mark.

---

resulting familiarity with the general flow and character of work in both sites, we feel the influence of the observer was minimal.

3 The fieldworkers spent many weeks in the collaborative effort of developing, testing and revising this data collection instrument in its various iterations in both sites. Inter-rater reliability was a key consideration during this process. Following each of several periods of field testing, coding protocols were discussed and revised to ensure consistency among the observers.

SHADOW OBSERVATION SHEET

Person: _____

Date: _____

Page _____ of _____

Event Type Key:

w=work
a=PA announcement
f=face-to-face
ff=failed f-to-f

p=telephoned
pr=telephone received
pf=failed telephone
pm=left telephone msg.

d=sent document
dr=received document
dv=viewed document
o=other

m=reading news
pn=posting news
t=displayed temp. display
tr=read temp. display

e=sent email
er=received email
ev=viewed email
c=interruption

Time		Focus		Location (specify)	Event type	Task Number	Sender/recipient	No communication with this person before?	Project					Focus Indicate T=technical and/or M=management							Scheduled Communication									Probed?	Comments/Notes
Start	Stop	Tape #	Footage						None	Hara	NPD System	Other Work	Personal	Generate ideas	Build consensus	Give Info.	Receive Info.	Request Info.	Make document(s)	Solve Problem(s)	None	Prior to prev. wk. day	Prev. wk. day	Today	None	Today	Next wk. day	After next wk. day	Unspecified		

Figure 3.1   Shadow Observation Instrument: Site 1 (70% Original Size)

Next, the "Location" column indicates where the activity took place. The default is the subject's office and is indicated by a blank field. Any other entry locates the activity in a specific physical space. For example, if the subject participated in a conversation with another individual at a photocopy machine, "copy machine" would be written into the location column. Prior to data processing, this entry would later be assigned a unique numeric code corresponding to that location. When the data pertains to an actual or attempted interaction with another person at that person's office or desk, "office" or "desk" is entered by the observer in the location column; this notation was subsequently assigned into a unique numerical value based on the interactant involved.

The "Event Type" column is used to record communicative and a non-communicative events. For the purposes of this study, a communicative event is defined as an observably distinct interaction involving the subject and another participant(s) using a particular communication channel (e.g., the subject telling the secretary she will be out of the office for 1 hour). In contrast, a non-communicative event is defined as a discrete, observable, non-communicative activity (e.g., recalculating a project budget. In categorizing an event observers also considered the communication channel involved (e.g., a hand written note from a coworker). These factors generated a typology of events indicated on the shadow observation form in Figure 3.1. Most of these events are generic and could be used to classify actions in any office setting, but as a set they reflect the most significant events and communication technologies observed in NPD. Though many are self-evident, the operative definitions for these events will be reviewed briefly here. "w" refers to work and is used to mark non-communicative, task-related activities. Public Address announcements were coded "a". Face-to-face interactions were coded "f". When the subject attempted to meet with another person but was for some reason unable to meet with that person, the event was coded as "ff" (i.e., failed face-to-face). When an observed telephone call was initiated by the subject the event was coded "p"; when the phone call was received by the subject the event was coded "pr". Failed attempts to reach another party over the telephone were coded "pf" unless a message was left in which case the "pm" code was used instead.

Sending and receipt of documents were coded as "d" and "dr", respectively, and the viewing of a document was coded "dv". Parallel to the codes used for documents, "e", and "er" refer to sending and receiving electronic mail, "ev" refers to viewing electronic mail4. Among many workers in NPD, electronic bulletin boards and news groups are an integral part of the information and communication matrix. Time spent reading entries in the electronic news groups was coded "rn" while posting articles or information to these systems was coded "pn".

Temporary displays include a unique range of communicative phenomena that usually occur in the context of meetings or other face-to-face interactions. In

---

4   The "viewing" of electronic and hardcopy documents proved to be an extremely difficult to observe and record in the field. Though in theory one can discriminate between these discrete viewings, in practice it is problematic. Subjects often viewed several different electronic and/or hardcopy documents in rapid succession. For example, software engineers often employ windowing systems which allow them to view two or more distinct electronic documents on one screen at one time. In addition, hard copy printouts and manuals are referred to while working out a software problem on the screen. The rapid succession of glances from window to window to manual to printout proved to be a level of action most observers are incapable of recording with high levels of accuracy. Since the "ev" and "dv" events are a special subset of solitary work activities ("w"), they were collapsed into that category for analysis. Though the nature of work in the second site was such that this observational/coding issue was less problematic, these codes were collapsed in the analysis of data from the second site as well in order to preserve the comparability of those data with data from the first site.

contrast to documents which are created and distributed in an essentially permanent form (thus the commonly used terminology, "hardcopy"), temporary displays consist of written and graphic information such as sketches on whiteboards, chalkboards or other media resulting in "documents" which are not permanent. Creating and reading temporary displays were coded as "t" and "tr", respectively. Any non-work related activity was coded "o".

The next column, "Task Number", is used to identify *tasks*. We define tasks, from the perspective of the subject, as discrete work objectives (e.g., a project report). Tasks are addressed by workers through *events*, which we define as observable actions. Viewed within the context of collaborative work, we discriminate between events which are communicative (e.g., speaking to a co-worker over the telephone) and those which are non-communicative (e.g., using a calculator). Tasks may begin and end with a single event or may continue over time. Events may be constitutive of one or more specific tasks (e.g., planning a meeting with a vendor, writing a piece of computer source code, meeting with a supervisor to resolve a personnel issue). Some events, however, may not be constitutive of any specific task, but may be constitutive of a non-specific task. Non-specific tasks are usually work-related and serve a "housekeeping" or self-management purpose (e.g., clearing off a desk, going through an in-basket, etc.). Specific tasks are identified and numbered sequentially as they are initiated during the day. When a specific task reappears later in the day its original task number is maintained in the coding in order to track the time and activities associated with these tasks. Non-specific tasks, however, are assigned a task number of "0".

Tasks and events cluster in particular ways; these clusters we refer to as episodes. *Episodes* are defined as units of temporally bounded activity, and can be further divided into simple and compound forms. A *simple episode* is defined as a unit of temporally bounded activity involving a single task and event which may or may not involve communication with other individuals. If the simple episode is communicative, it is restricted to a single channel. A *compound episode* is defined as a unit of temporally bounded activity which may involve more than one task and/or more than one event (e.g., a face-to-face conversation [the first event] pertaining to a management plan [the first task] in which the subject creates for the other interactant a pencil sketch of the plan [the second event] followed by further discussion of an unrelated design problem [the second task]). As this example shows, compound episodes may involve more than one channel (i.e., information is carried simultaneously through face-to-face conversation and documentation). Similarly, multiple tasks can be addressed through a single event (e.g., a face-to face conversation may involve discussion of several discrete tasks).

The "Sender/recipient" section identifies other persons involved when the activity is communicative in nature. Where the interaction is initiated by someone other than the subject of the session, that person's name is circled unless the event type already identifies the initiator (e.g., "er" indicates email received by the subject).

The next column, "communicated with this person before?", was intended to mark the occasions where first time communications between the subject and another party was observed. Such first time interactions were rare in the course of the normal workday for Nova and Mars project members and the default assumption was that the interactants had communicated, and in such cases the column was left blank. When first time communication was observed, the column was marked with a check.

The "Project" column linked observed actions to specific workgroup projects. The alternatives for this column included "Nova", "Mars", "NPD System", "Other work" and "Personal". The first two project alternatives, "Nova" and "Mars", refer to work related to the activities connected with the Nova integration or Mars component projects targeted for study. "NPD system" included a range of non-project specific background activities including a range of tasks such as product maintenance, evaluation, and release. "Other work" was a residual category which accounted for activities related to other projects. For example, if a member of the Nova team spend time on another project (a common occurrence with the matrix management system in place in NPD) those activities would be marked "other work". Non-work related activities were classified as "personal".

The next set of columns is used to indicate the "Focus" of the communicative events. The goal of the "Focus" section is to capture the focus of the interaction from the point of view of the subject (i.e., the person being shadowed). The check-all-that-apply alternatives were "generate ideas", "build consensus", "give information", "receive information", "request information", "make decision" and "solve problem". Based on familiarity with the context of the communication as well as occasional probe questions asked of the subject, the researcher marks whichever dimension(s) of focus is applicable to the observed interaction (e.g., if the subject made a phone call looking for a phone number, the "request information" section would be marked). The focus of the interaction is further classified according to whether the focus of the event is primarily technical ("t"), managerial ("m"), or both ("t/m)". While a technical focus of an interaction is self-explanatory, a managerial focus was defined as one concerned with the allocation or management of material and/or human resources (e.g., if the subject met with a supervisor to finalize a salary increase, the Focus column "Build Consensus" would be marked with an "m").

The next column, "Scheduled Communication", provides chronological information about known preceding and anticipated future communication with the given interactant about the given task. If there was no such prior communication, the observer marked the box "none" with a check mark. If there was such prior communication(s) the most recent such communication is located in time by marking one of three choices: "prior to previous work day", "previous work day" or "today". When the corresponding channel is known to the observer, the appropriate event code is entered in the column; when it is unknown, a check mark is used. If no such further communication is scheduled, the "none" column of the "further" section is marked. If, however, the observed interaction results in the scheduling of further communication between the parties regarding the same tasks, one of four alternative temporal frames is marked: "today", "next work day", "after next work day" or "unspecified". The final choice, "unspecified", was used in cases where the parties specifically agreed to communicate again on the topic but did not indicate when they would next communicate. If the participants specifically arranged to communicate again about the task and agreed on a particular channel for that communication, the event code which indicates that channel is entered in the column; if the channel was not indicated (e.g., "I'll get back to you") "unspecified" was coded. Where inapplicable or where the information is unknown, sections of the "Scheduled Communication" columns are left blank.

Throughout the study, the observers attempted to limit their intrusions as much as possible. In most cases, the pattern of daily work activities and interactions were observed and recorded and attempts were not usually made to engage the subjects in discussions of their actions. When additional information was solicited by the

observers (i.e., when probe questions were asked in order to clarify or complete the data collected by observation) the column, "probed?", was checked.

The final section of the shadow sheet, "Comments/Notes", provides space for brief notes concerning the actions charted on that particular row.

3.1.4.2 Shadow Observation Instrument: Site 2.

Refer to Figure 3.2 for the following description. The observation instrument used in the second site was elaborated and adapted from the instrument developed for Site 1. Several refinements were made based on insights gained in the first site and several iterations of the instrument were field tested before a final version was deployed. Some of the changes reflected in the shadowing instrument are cosmetic, and attempt to better organize the observational categories in order to make the coding process easier for the field observer. Others are the result of continued refinement in the questions which underpinned the study. Still others involve the need to expand the range of event types to include events not observed in the first site. In every case we attempted to capture the maximum amount of information while designing an instrument which fit the communicative environment of the second site. In this section a brief overview of the shadow observation instrument and coding protocols for Site 2 will be presented.

Several new event codes appear on the Site 2 observation Sheet. While field testing pilot versions of the Site 2 Sheet, it became clear that an important activity for many of the workers in the second site was sorting through in-baskets. This activity was coded "b". This code refers to a specific mode of work wherein many documents are quickly assessed, passed on, thrown out, filed, or ignored.

Two additional modes of communication were used in the second field site which were not available in the first: electronic broadcast and facsimile document transfer. Electronic broadcast, coded as "eb", was a feature of the computer network in place in the second site which enabled a "pop-up" message to appear on the screen of the addressee. In addition, electronic facsimile transfer emerged as a significant mode of communication in the second site so new codes were introduced to mark its use, "df" and "drf".

Finally, additional events were introduced to gather more detail concerning the modes of document transfer in site 2. Thus event types were designed to represent documents transferred by hand ("dh" and "drh"), by US mail ("du" and "dru"), by internal company mail ("di" and "dri"), and by overnight express mail ("dx" and "drx").

"U" was used to code events which were potentially interactional yet were unacknowledged by the subject. For example, on many occasions we observed secretaries placing documents in an in-basket while the subject was occupied with some other task. Though the subjects saw the document in many of these cases, they did not acknowledge the secretaries or look at the documents. In such cases the "U" code was used.

Other event codes introduced in the second site allowed us to document the process of work activities more closely. For example, where we had only coded the display and reading of a temporary document in Site 1, in Site 2 we introduced the additional "tc" code for the creation of a temporary display. Similarly, "dch"

NWREL Shadow Observation Sheet

Person: _____
Date: _____

Event Types:
[r] = received
[s] = scheduled

w = other work
c = interruption
o = other channel

f[f] = face-to-face
sf = scheduled f
ff = failed face-to-face
b = in/out basket
x = photocopying

dv [ehl] = doc viewed
dc[e/h] = doc created
tc = tmpdisplay created
tv = read tmpdisplay
v[r] = voice mail

p[r] = phone
sp = scheduled phone
pf = phone failed
pm[r] = phone message
pb[r] = phoned back

d[r]h = doc byHand
d[r]u = doc USmail
d[r]i = doc InternalMail
d[r]x = docEXpressed
d[r]f = docFAXed

e[r] = email
ev = email viewed
ec = email creatInd
eb[r] = Broadcast
ebc - Broadcast created
ebv - Broadcast viewed

Use circled numbers to point to fieldnotes.
Indicate type of document

Document Types:
M = memo; R = report; PM = phone message or describe

Time
C = Continued
tL = tLlnterviewed
Start

Location (specify each)

Event Type (codes)

Task Number

Participants
S = Sender
R = Recipient(s)

For each:
o = original doc
c = cc'd on doc
rt = routed order
(Circle Initiator)

Mediated? (name)

Focus (Indicate roles)
T = Technical M = Management

Generate ideas | Build consensus | Give Info | Receive Info | Request Info | Make Decision | Solve Problem | Schedule | Id. Responsibility | Redirect/Refer

Scheduled Communication

Prior: Prior Event | when: N-2-10U

Further: Further Event | when: N012U

participants change? | location change?

Comments/Notes

Researcher: _____
Page ____ of ____

Figure 3.2   Shadow Observation Instrument: Site 2 (70% Original Size)

(document created by hand) and "dce" (document created electronically) codes were introduced in the second site.

A phone call returned in response to the receipt of a phone message is coded "pb" for "phoned back", while dialing into a scheduled telephone call (e.g., a prearranged conference call is coded "sp" for scheduled phone). The receipt of a phone message, "pmr", was given its own code in Site 2. Such events were coded as document received in the first site.

A new column, "Mediated?", was introduced to record details concerning the role played by people or technologies in mediating a communicative event. The coding options were: group member, secretary, receptionist, electronic, or other (e.g., if a secretary took the message and passed on the information the section would be marked "sec").

We expanded the range of choices in the "Focus" section of the observation instrument in site two. Additional entries were: "schedule", "identify responsibility", and "redirect/refer".

Within the "Scheduled Communication" columns, the "When" section situates the prior and further communication within a range of times. Choices for these sections are "N" (no prior or further event), "0" (same day), "-2" (2 or more work days prior), "2" (2 or more work days future), "-1" (prior work day), "1" (next work day), and "U" (unspecified).

Two additional columns were added to the revised observation instrument. The "participants change" and "location change" columns were marked if the prior or further scheduled communication involved a participant(s) other than the one(s) indicated in the "Participants" section, and if the location of the prior or future interaction did or would take place at a location different from the location of the current interaction.

Additional information pertaining to the qualities of hard copy documentation was coded in the "Comments/notes" column. Original documents were coded "o", copies coded "c" and routed documents "re". In practice, however, it turned out that it was not always possible to determine these qualities. Consequently this information was recorded only where possible.

3.1.4.3 A Coding Example. The following section provides an illustrative example of coding and protocols employed in this project. This example illustrates use of the shadow observation instrument deployed in the second site. Refer to Figure 3.3 during the following description.

The first row of coded data illustrates a simple episode with one communicative event. At 7:30 the subject s

(John) phones a coworker (Liz) to ask the name of a vendor. The interaction does not represent the continuation of an interrupted interaction so the "C/U" column is left blank. John makes the call from his desk (the default category) so the location column is blank. Liz is the participant and her name is recorded in the "Participants" section. Because she did not initiate the interaction, her name is not circled. The interaction involved a request for information in order to solve a technical problem (from John's viewpoint), so the "Focus" section is marked with a "t". There was neither prior communication nor is further communication

NWREL Shadow Observation Sheet

Person: John   Date: 5/25/89

Event Types: [r]=received [s]=scheduled

w =other work
c =interruption
o =other channel

f[f]=face-to-face
sf =scheduled f
ff =failed face-to-face
b =in/out basket
x =photocopying

dv [eh] =doc viewed
dc [eh] =doc created
tc= tmp/display created
tv= read tmp/display
v[r] =voice mail

p[f] =phone
sp =scheduled phone
pf =phone failed
pm[r] =phone message
pb[r] =phoned back

d[r]h =doc byHand
d[r]u =doc USmail
d[r]i =doc InternalMail
d[r]x =docEXpressed
d[f] =docFAXed

e[r] =email
ev =email viewed
ec =email created
eb[r] =Broadcast
ebc =Broadcast created
ebv =Broadcast viewed

Researcher: AlF   Page 1 of 6

Use circled numbers to point to fieldnotes.
Indicate type of document.

Document Types:
M=memo; R=report; PM=phone message or describe.

Time Start	C=Continued u=u[nacknowledged]	Location (specify each)	Event Type (codes)	Task Number	Participants S=Sender R=Recipient(s) / For each: s=original doc o=sent on doc r=re-routed order (Circle Initiator)	Mediated? (name)	Focus (indicate roles) T=Technical M=Management — Generate Ideas / Build consensus / Give Info / Receive Info / Request Info / Make Decision / Solve Problem / Schedule / Id. Responsibility / Redirect/Refer	Scheduled Communication — Prior Event / when: N-2-10 U / Further Event / when: N 0 1 2 U / participants change? / location change?	Comments/Notes
7:30			ρ	1	Connet, Liz		T (Request Info), T (Solve Problem)	N / N / 2	John asks Liz for name of vendor — Liz says Union Carbide
7:31		stock room	w	∅					John goes to stock room for supplies. As he sits down his phone rings
7:42			pr	1	Connet, Liz		T (Receive Info), T (Request Info)	ρ / O / N	Liz says giving him wrong name — not Union Carbide but 3M
				2			T (Give Info)	sf / -1 / 2 / ✓ / ✓	Liz asks technical question about the new sales composition plan — "what % at risk" -phone??
7:45			dvh	3					Viewing notes on new product
			dce	3					transcribing notes to computer

Figure 3.3   Shadow Observation Instrument: Coding Sample

(70% Original Size)

scheduled, and so the columns are left blank as are the participant and location change columns.

The third and fourth rows depict a compound episode composed of two tasks and a single communicative event. Realizing she had given John the wrong name, Liz phones John at 7:42. The "Event Type" is marked "pr" to indicate John received the phone call. The task is coded "1", representing the reemergence of this task in John's work day. Though the task appears earlier in John's day the preceding event was not interrupted so the "C/U" column remains blank. John received technical information so the "Focus" is marked with a "t". There was a previous communicative interaction involving this task (John's phone call to Liz at 7:30) so the "Prior" columns are marked "p" (phone) and "0" (today). John and Liz scheduled no further communication regarding this task. However, before the call was completed, Liz asked John a technical question regarding the new sales compensation plan announced at yesterday's staff meeting. This conversation raises a new task which is coded by the observer as "2". The details of the interaction, now focused on task "2", are recorded on a new row. In regard to this task, the Focus (from John's point of view) was on giving technical information.

John and Liz both attended the meeting yesterday and discussed the plan during the meeting. Thus the Prior Scheduled Communication section is coded "sf" (scheduled face-to-face) and "-1" (previous workday). The Further Scheduled Communication row is marked "n" since no further communication was arranged. Both the "participants change?" and the "location change" columns are marked since yesterday's meeting involved other participants (besides John and Liz) in a different location.

Rows 5 and 6 illustrate a compound episode involving one task and two events. At 7:45 John began reading notes he had written regarding a new product he will be responsible for, at the same time he transcribed the notes into his computer. Reading the notes is coded as event "dvh" (document viewed, hardcopy) and transcribing the notes is coded "dce" (document created, electronic). Though the "dvh" preceded the "dce" the two events are inseparable. The task addressed in this sequence has not appeared before in today's activities and is assigned the task number "3" by the observer. Because this sequence involves non-communicative events, the "Focus", "Mediated" and "Scheduled Communication" sections are not coded.

3.1.5 Collection of communication samples: Documents, electronic mail and sound recordings.
Throughout the research project, but especially during the periods of formal shadowing, samples of hardcopy, oral and electronic workgroup communication were collected. Copies of hardcopy documents sent or received during the shadowing sessions were collected as appropriate and when possible.[5] Both incoming and outgoing electronic mail messages were automatically (and invisibly) collected for the members of the targeted workgroups.[6] In addition, audio recordings were made of a limited sample of different types of workgroup

---

[5]   Because some workgroup communication was extremely sensitive and proprietary in nature, there were occasions when we did not obtain copies of some documents.

[6]   With each individual's written permission, the computer system automatically collected copies of their email throughout the field study (not just on days on which an individual was shadowed). These copies were logged to a cumulative "capture" file to which only that individual had access. Individuals knew they would have a chance to review (and edit if necessary) their capture file before it was submitted to the research team at the end of the study. Because of this

interactions in both sites and of nearly all conversations at the desk of Site 1 shadowees. Audio recordings proved much more difficult to collect in the second site than in the first, and as a consequence the recordings for the second site are few. Primary among the reasons for the difficulty was a heightened concern with security and proprietary issues as well as a higher level of unease concerning the obtrusiveness of audio recordings.

3.2 Structure of the fieldwork

Before formal data collection began in each site, it was necessary to become familiar with the field settings. In much the way an anthropologist working in a foreign country must learn the language of the people he or she studies, the research team needed to learn the "languages" of NPD and CSD and their constituent groups. Though both the researchers and the subjects speak a common language--English-- the subjects in both settings speak unique technical and occupational dialects which the researchers, as outsiders, initially found partly unintelligible. Questions framed and issues proposed for exploration during the development of the proposed project required translation into the language of the work setting to make sense to the subjects; similarly, to understand the answers required some fluency with the language and concepts of the Io Products and Parallax Corporations. Collection of shadowing data similarly required an understanding of ongoing work and activities in emic terms, i.e., within the conceptual framework of the workers.

As in more exotic locales, during the early days of the fieldwork in each site, the researchers relied on "native" interpreters and guides to help them initially find their way through the organizations. During this period the researchers learned the structure of the organizations. As in any social system, the structures, which comprise the system are often opaque and sometimes invisible to outsiders. Time was spent interviewing a wide range of workers and observing a cross-section of activities as part of an attempt to piece together an understanding of the roles, statuses, lines of authority, history, values, goals and other facets of the organization. Over time we slowly gained an understanding of the social context of the field sites. With this understanding it was then possible to translate the research questions and objectives developed prior to entry into the field into forms which made sense within the particular contexts of NPD and CSD. At the same time, the knowledge gained during this period enhanced our ability to interpret and understand observed behaviors.

Fieldwork in each site was thus conducted in two phases. The first phase involved a period of several months of informal research wherein the researchers employed traditional ethnographic methodology and collected data to provide a general overview of the structure and organization of the targeted workgroups within NPD and IPC. Instruments were developed for recording details of observed and self-reported communication and work activities. Software was developed to enable automatic collection of electronic messages. Next, final decisions were reached as to which of the targeted groups would best meet the requirements of the study. Once the final target workgroups were determined, the researchers sought clearance from several layers of management and target group members themselves to begin the second phase of data collection. To gain the necessary cooperation, presentations of the goals and methodology of the study were then made to the

approach, participants were not concerned about confidentiality issues during the course of the study and the email collection remained inobtrusive.
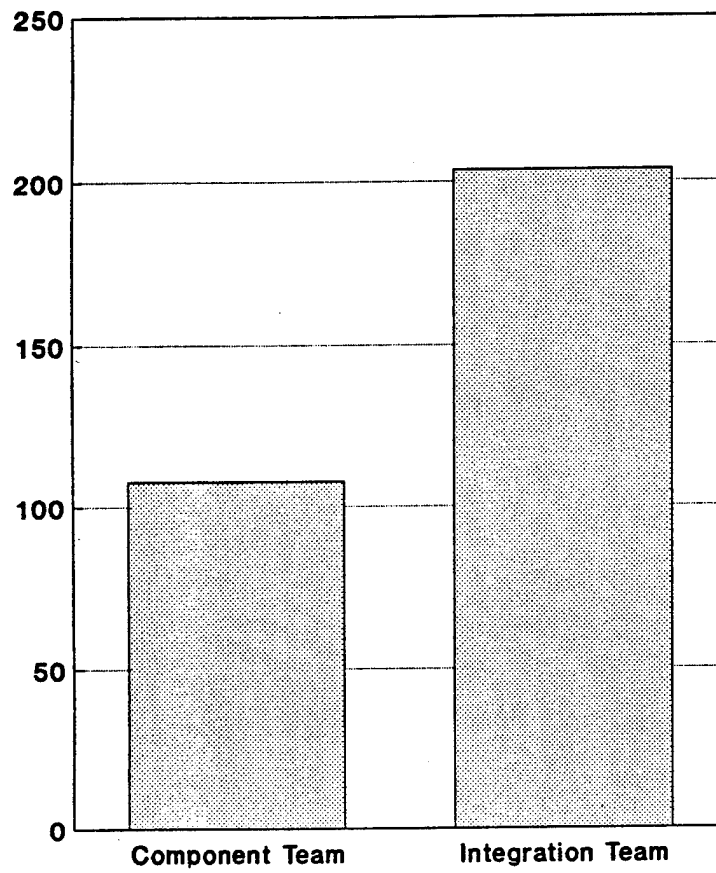
Figure 3.4   Hours Shadowed: Site 1
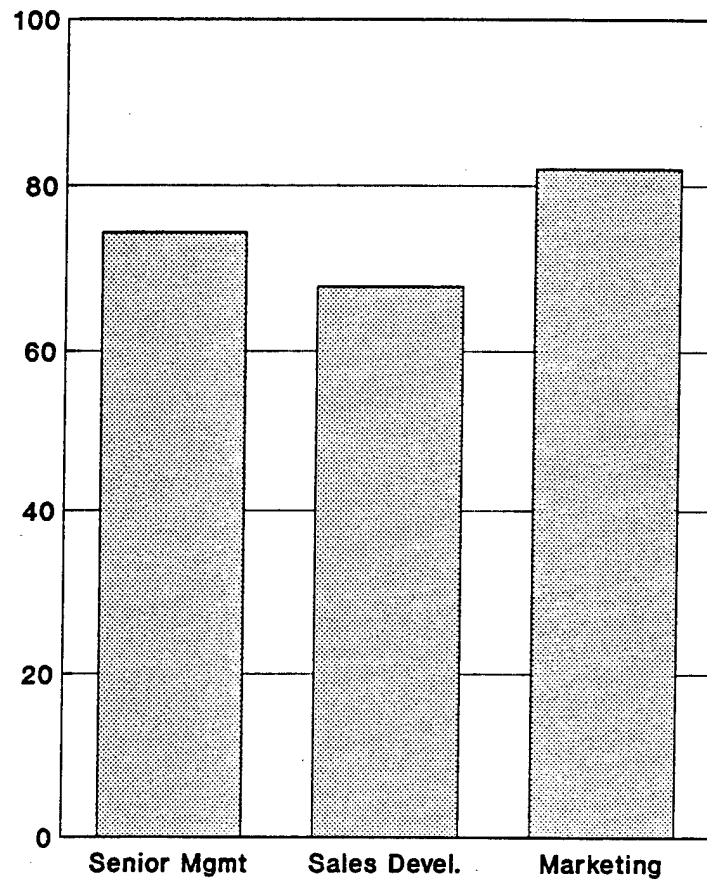
Figure 3.5   Hours Shadowed: Site 2

target workgroups. Individual discussions were subsequently held with the members of each group. The second phase of fieldwork in each site involved systematic collection of a variety of data during shadowing sessions.

3.2.1 The Structure of the NPD Study. Phase I research was conducted during the period April - August, 1987. Phase II research was conducted during an 11 week period during October 1987 - January, 1988.

Given the relative sizes of the two target groups (approximately 7 in the Mars Component group and 13 in the Nova Integration group) for Phase 2, it was not possible to shadow all members of these groups. Consequently, 4 individuals from the first group and 7 from the second were selected for shadowing. Each of these subjects was shadowed on four days according to a quasi-random, rotating schedule, resulting in detailed observational records of communication events and work activities, and collected communication materials. Hours shadowed for the Component team totalled 107.67 while the hours for the Integration team totalled 203.65 (Figure 3.4).

3.2.2 The Structure of the CSD Study. The study in the second site was conducted over a period of 12 months between July 1988 and July 1989. Phase I data collection was preceded by two months of orientation and negotiation with CSD management. Phase II data collection started in April 1989 and lasted 10 weeks During this period 12 members of three targeted workgroups were shadowed. Six individuals from the nine person Senior Management Team were shadowed, and of these six, data from five were entered in the database.[7] Coverage among these five amounted to nine workdays and a total of 74.38 hours.[8] Four of eight individuals from the Sales Development Group were shadowed over 10 work days and a total of 67.80 hours. All three members of the Marketing Group were shadowed over 15 working days for a total of 82.03 hours (Figure 3.5). During the period of the study, the shadowing sessions involving the Senior Management and Marketing groups were conducted at the CSD headquarters. Sessions for the Sales Development Group were carried out in three remote field offices.

---

7   The sixth individual left CSD during Phase II of the project.

8   The total hours represent only periods covered during the shadowing sessions and not necessarily periods "worked". If, for example, a worker came back to work in the evening of a day he or she was "shadowed", that time would not appear in our records. Similarly, the total days do not necessarily represent full days. Though not usually the case, there were occasions when a person left the office for a personal or business appointment and the shadowing session was ended prior to the finish of a normal workday.

4.0 Site 1: QUALITATIVE RESULTS

This chapter presents qualitative data collected during the study of the first field site, Io Products Corporation's New Products Division. These data are intended to complement the quantitative data which appear in chapter 5 and to parallel qualitative findings from the second field site which are presented in Chapter 6. The goal in this chapter is not to present a detailed ethnographic depiction of the workplace, but to focus on contrasts in workstyle, styles and genres of communication, and channel choice and channel switching.

4.1 Workstyle in NPD

In this section we will examine patterns of work in NPD, with particular attention to contrasts between the Nova Integration and Mars Component workgroups. Figure 4.1 provides an overview and summary of these contrasts.

Both the Nova Integration and Mars Component workgroups were product oriented, assembled specifically to engineer new products for NPD. These efforts were relatively short-term, high-burst projects. In neither case were the projects expected to continue for more than roughly one (Mars) or two (Nova) years. The constituent tasks for each project were relatively discrete and progressive; both projects were envisioned as development projects involving the completion of a series of separate tasks. At NPD, product design, development, testing and marketing was seen to be a linear process. This linear model was pervasive among the groups studied in NPD and a product "path" metaphor framed all the project activities. Tasks were "charted" along a "timeline" with "milestones". "Breakdowns" stopped or slowed progress and workers "stretched" for "breakthroughs".

The Mars Component team was headed by a project team leader but individual team members were responsible to various managers as a result of the matrix management style practiced by NPD (Figure 2.1). The structure of the Nova Integration team, on the other hand was somewhat more complex. This project was headed by a project manager, who had nominal responsibility for the project yet as a result of the matrix management system, had little power to direct the other members of the team. In his own words, "I have no stick. I can only persuade." The Nova team also included a NPD hardware manager to whom many of the hardware engineers reported.

The Mars team was composed of a core group of engineers whose cubicles were located close to one another. Other group members with peripheral responsibilities were located further away though still within one or two minutes walk. In contrast, the Nova team was more widely dispersed with the members of task/component sub-groups located close to one another, and sub-groups distributed throughout the building. In both cases, worker location tended to be a function of the technical specialties of the workers, i.e., software engineers tended to be located with other software engineers. A notable exception to this pattern was the Nova Integration project manager whose cubicle was close to but separate from the range of engineers and technicians involved in the project.

The style of cooperative work among the members of the Nova integration team varied depending on the task, stage of the project and responsibilities of the members involved. Though the tasks assigned to each Nova group member were

workgroup	nature of work/modes of work	location	travel	physical space	available channels	history/context	homogeneity/composition	span of responsibility
Component	product oriented; short term goals; individual tasks highly integrated; work with core group	proximate core group; peripheral members locally dispersed	low travel	u-benches and cubicles	phone, email; no voice mail; no secretarial support; machine mediation of communication very high; human mediation low	group assembled for project	team leader; two complementary sections of core group; team members matrixed	responsible to team leader and section managers
Integration	product oriented; short term goals; sub-group tasks integrated; work with sub-groups	most sub-group members proximate; sub-groups locally dispersed	high travel for Project Manager, low for others	u-benches and cubicles	phone, email; no voice mail; low secretarial support for Project Manager, none for others; machine mediation of communication very high; human mediation low	group assembled for project	Project Manager; sub-groups responsible for components; team members matrixed	responsible to Project Manager and section managers

Figure 4.1   Contrasts in Workgroups: Site 1

ultimately linked to the task of every other member, for many team members there was often little need to interact on a day-to-day level. At critical junctures in the project, the whole group met to coordinate activities, but for the most part the project manager was responsible for coordinating the accomplishment of tasks among the sub-groups.

Because Nova was essentially a project involving the integration of a range of components, and group members were drawn from a range of technical departments, sub-groups were formed within which collaborative activity was often intensive and ongoing. For example, one Nova team member was a mechanical engineer responsible for making sure the metal and plastic frame and case ("skin") he designed could contain the electronic hardware the project's electrical engineers envisioned. During the period of the project in which the electronic hardware was continually revised and specifications reworked, the mechanical engineer had to maintain close contact with the electrical engineers so that they could collaborate on the design. Both the mechanical engineer and the group of electrical engineers needed to discuss the implications of changes and design alterations on the tasks of each other on an ongoing basis.

Another significant sub-group among the Nova team was composed of the system software designers. This sub-group was especially interesting in that the majority of their project communication was carried out by way of electronic mail. All three of these individuals remarked that email was by far the quickest and most efficient means to communicate project information. All had extraordinary keyboard skills and could compose and send complex sets of questions and answers with phenomenal speed. Typically, one engineer would work on a piece of code and interact with one of the other two to provide status reports, or when there was a specific problem. When problems emerged, an email message was sent to one of the other two describing the "bug" or problem and identifying the machine, directory and file name in which the problem code could be found. The recipient would then review the problem, ask for additional information, and suggest an alternative. On the other hand, this sub-group of software engineers had little or no cooperative interaction with the mechanical engineer or the prototype technician. Though the success of the project ultimately depended on all the Nova team members, the majority of collaborative effort involved sub-groups of the project team.

In contrast to the Nova project workers, Mars team members generally practiced a much more collaborative style of work. The scope of the task shared by the Mars team was narrow in terms of the range of disparate activities. Tasks for this group were often modular and the development and completion of one task was often interlinked with another. Thus team members spent significant amounts of time working collaboratively, not merely coordinating their activities.

The following transcription depicts a conversation between Tasha Larson, Senior Software Engineer and Mars project leader and Woody Jasper, a junior engineer recently hired by NPD. At issue was a "boot error" problem which was holding up progress toward a major demonstration of the MARS system at the New Products Show. Tasha and Woody had already met twice during the day and Tasha was guiding Woody's attempt to resolve the software problem. Earlier in the day they had discussed the probable cause of the boot error and Woody had work by himself and then collaboratively with other engineers in an attempt to resolve the problem. Later in the afternoon, Woody returned to report on progress and to seek clarification from Tasha concerning next steps. In the transcript which follows,

Tasha and Woody discuss the implementation of the MARS software on Tomato, the main software development computer.

Woody: Couple things. Um...successful mount over there on the new box both MARS, Cyber and Tomato. Ok, so we did mount with the new software that we installed on the box. That's good. Um...this change with Tomato, on what you want to do...I guess...apparently...I didn't understand it or it might not work. You want...you want me to drop off the tape?....

Tasha: Let's drop back a little bit.

Woody: Okay.

Tasha: We talked a couple of weeks ago...

Woody: Uhuh...

Tasha: ...about the fact that the control files problem on Tomato were not the ones in the build tree. Remember talking about that?

Woody: The control files? Right, and then we had a...we ch....

Tasha: Right. Like RC, and that you were going to work on...

Woody: Yeah, and I changed...and I changed the make files...

Tasha: ...so that the ones in the tree would be right.

Woody: Right.

Tasha: Okay...

Woody: ...and I went in and changed...

Tasha: That's been done?

Woody: Yea, RC, RC net...

Tasha: Ok...

Woody: ...and...

Tasha: Did you change fixup to start using them? Did Keith change fixup so that we are actually using them?

Woody: Should be...yeah.

Tasha: Okay. So, now, at this point there is very little difference other than the mechanism between what we build and what we run.

Woody: Right

Tasha: Is that correct?

Woody: Exactly.

Tasha: Okay. Then there are few a files that are personal, such as password file, which we may have a default for but in the install procedure, hopefully, there is some provision for a user to not wipe them out.

Woody: Right.

Tasha: Is that true?

Woody: Not an install procedure. We use...is...well, actually no...

Tasha: The customer...

Woody: Yeah...yeah...

Tasha: ...When you send it to the customer....

Woody: Right. Exactly.

Tasha: ...the customer has some procedure he follows in which when he is done, he, if he wishes, still has his old password file.

Woody: Uhuh. Install has....

Tasha: Is that true?

Woody: Yeah. Install has a list of files that are copied to some other source so when the stuff is dropped on the stuff is copied back and so they don't lose those files. Correct.

Tasha: So, you can do an install on Tomato and we will run just like we have always been running because all the prepatory work has been done. Is that true?

Woody: Exactly, and I have been doing install on Tomato.

Tasha: But not the way a customer does it and not the way we're doing it on those boxes. You've been doing a different kind of install.

Woody: The only...basically it's the exact same install except I'm not at / , I'm at /IONIX.MARS.

Tasha: Right, except that...That's a big but.

Woody: Okay. If we install at /...

Tasha: Yes...

Woody: ...We lose all the functionality at being able to switch back and forth, and we will lose it and Keith says it's really...he didn't know right off hand how to do that and still be able...

Tasha: Well...

Woody: ...to do the switch back and forth.

Tasha: Make a...I don't care if you restore a release tape to switch back and forth...

Woody: Okay.

Tasha: You know. Whatever works.

Woody: Okay

Tasha: Uh...if you do that, can you...does CPIO work now? Can you install?

Woody: I just tested that right now...uh...I'm just...

Tasha: I mean it has to work for the Product Standards Show?

Woody: Right.

Tasha: Right?

Woody: Right, and I just installed new...uh...we've been having problems...uh...Tolly Bosch was having problems with some of the stuff that got installed. In the intermediate we had a corrupted tape installed...you know, about 30 files that were bad, and so I redid the CPIO and re-installed them and that seemed to work and CPIO worked so...

Tasha: Okay. Now we've got a bug in CPIO that's assigned to Lon. I haven't checked the status lately...(refers to hard copy document listing unfixed software bugs)

Woody: Right.

Tasha: ...to see if it's marked fixed. You know what the status of this is?

Woody: All I know is, with the kernel that we had, we didn't get the segmentation problem. It went ahead.

Tasha: This...(taps on document) this has to be double checked before you can afford to go full MARS. Would you agree with that?

Woody: Yeah...yeah...definitely, 'cause you can't install your files without CPIO.

Tasha: OK. That's the order in which things have to be done. First you have to verify that this works and then we can take Tomato to full MARS. Now before you do take Tomato...first be sure you know how. Okay? Once you know how, send email to the whole group and say, "Here's how I'm going to do it. Here's why it will work. Anybody see a problem"?

Woody: Okay.

Tasha: Okay, and give them at least 24 hours to respond and then do it.

Woody: Okay, and then...

Tasha: Which would mean you'd want to do that almost today in order to have any time for any response in doing it before Christmas.

Woody: Yeah, what I wanted to do is I wanted to install it tomorrow when I had the new tape from the build that didn't finish building...

Tasha: OK. So you want to send email right now.

Woody: Okay.

Tasha: To MARSDEV.

Woody: Okay.

Tasha: Saying "Here's what I'm gonna do. Here's why I think it will work...."

Woody: I'll first verify this...

Tasha: You also...before you do it...you gotta verify this (taps document), yeah. You can send email first and then send that and then verify CPIO.

Woody: Okay.

Tasha: 'Cuz email will take longer now.

Woody: Okay. I'm going to talk to Keith about it first...

Tasha: Right...

Woody: ...as far as the fsuk and all that...but sure, ok.

Tasha: Cuz there are things we may not really be testing, because we're still playing the old versions.

Woody: Right.

Tasha: Can't risk that.

Woody: Right.

This example is interesting for several reasons. It is indicative (though somewhat obscure in places to readers without engineering backgrounds) of the flow of work activity in NPD -- in this case between a project leader and a junior engineer. As the transcript indicates, a great deal of energy and time can be required to ensure that coordinated work is accomplished. In addition, it is an interesting example of the strategic use of channels. In this case, Woody was advised to use email to gain group consensus (by default if his announcement of intent was not reacted to by the rest of the Mars team). A full discussion of channel choice and channel switching will be provided in section 4.4.

4.2 Genres of Communication and Communicative Style in NPD

The research conducted in this project is derived from a mix of data collection methods which link observations of behaviors to interpretations of meanings generated and shared among the members of the group or community under study. One approach we have developed is to focus on genres of communication characteristic of the selected workplace setting (Reder and Schwab 1989). Building on the work of Hymes (1962, 1972) and Bauman and Sherzer (1975) we have extended the "ethnography of speaking" to encompass additional communication channels (writing, telephone, electronic mail, etc.) identified in the sites under study.

The preferred style of supervision in the company is a weekly "one-on-one" meeting between an employee and supervisor. This is part of the company's overall "walkaround" management style. The "one-on-one" meetings rare invariably conducted face-to-face and in private. Some managers schedule their one-on-ones in advance; others prefer to "walkaround" and hold them on a more informal schedule. Because there are no private offices in this environment, one-on-ones are generally held in areas offering sound isolation from others--often in a private conference room or a remote cubicle or outside of the building. Third parties normally do not attend. One-on-ones do not follow a fixed agenda or have a routine interactional structure. We describe one-on-ones as being *functionally specialized* to the face-to-face channel insofar as they are conducted only in that way (in these groups).

Another genre of communication is the "project status meeting" which, although also functionally specialized to face-to-face contexts, has somewhat different characteristics. These meetings are always scheduled in advance (usually at a fixed time on a weekly, biweekly or monthly basis), held in conference rooms, and are attended by a fixed staff team assigned to the given project, although other interested parties freely attend. The agenda and interactional structure of these meetings is highly predictable. The project manager chairs the meeting, first sharing items of general interest with the team, then asking staff seated around the table to report in turn on the status of their component activities in the project. (Usually the individual status reports reference displays or charts showing steps, timelines, and the like.) Deviations, from or necessary changes to plans are noted, and generate "action items" which are immediately assigned by the manager to various individuals for follow up. Participants in status meetings often remark that the discussion should be carried on "off line" when the discussion of the particular point moves beyond the predetermined agenda items. Following the round of individual status reports, there may be an expanded, less structured discussion of particular problems or issues facing individuals or the team as a whole.

In contrast are several workflow-based genres of communication which serve to facilitate and coordinate the ongoing activities of individual team or group members. These communications typically arise on an as-needed rather than scheduled basis, and are usually problem-solving, assistance-giving or resource-sharing in nature. They tend to occur as clustered chains or sequences of highly focused interactions. They are not functionally specialized to one channel, and may involve face-to-face conversation, electronic mail and occasionally telephone conversations. Channel alternation and switching are common in such chains of communication. The participant groups are usually small in these communications, but may change in size and composition as needed information or expertise is sought, located and engaged.

43

The "IOC" or inter-office communication is a genre of text used to communicate "official" information. Historically specialized to hardcopy, IOCs are now functionally specialized to hardcopy or email, and transpositions between the two media are common. The IOC occasionally functions to inform the recipient, but more often serves to protect the sender or to establish the authority of a previously reached decision, evaluation or direction. IOCs have a fixed format (as do many genres of office memoranda). Some are sent to wide distribution lists, whereas others have very limited circulation.

There are also "brainstorming" genres of communication. These involve both face-to-face and computer-mediated interaction. Although brainstorming sessions have a consensual focus or purpose, they have no fixed interactional structure (even when formally scheduled). This holds true both when the sessions are conducted face-to-face or through computer-mediated communication. Face-to-face settings range from the environs of one person's cubicle to an entry way to a conference room to an outdoors table; the number of individuals involved varies from a couple to an entire workgroup, although 3-5 is the most common size. A collaborative product usually results from these genres of communication: a co-authored document (e.g., a set of priorities, a proposed plan, a technical solution), a complex diagram on a whiteboard, or some combination of such artifacts.

Perhaps the most frequently occurring genres of communication in this setting -- perhaps in any setting -- are phatic in nature, serving to establish and/or maintain social relations among group members. These range from informal chatter between colleagues in adjacent cubicles to conversations held during scheduled or unscheduled encounters in hallways, the cafeteria or common work areas. Many such interactions in this setting take place through electronic mail. Some individuals use walks around the work environment as opportunities for "spontaneous" encounters and conversations with others. Other individuals evidently prefer to do their "social browsing" electronically and develop tactics for accomplishing their social work through that channel.

4.3 Channel Choice and Channel Switching in NPD

When a particular genre of communication is conducted in some instances through one channel and in other instances through another channel, the particular channel selected in a given situation often carries special social significance and may impact both the content and form of the communication. Alternations between use of face-to-face and telephone conversation, for example, may carry different social meanings and potentialities. If face-to-face is the norm within a group for discussing certain kinds of issues, then use of the telephone in a given instance will likely carry some special social significance. These meanings are usually bound to the channel *choice* itself; if the party initiating the phone call were known to be out of the office or otherwise unable to carry out the conversation face-to-face, no choice is perceived as having been made and there are no ensuing social implications.

Channel choices are generally made and interpreted within a contextual framework shared by workgroup members. Channel choice behavior seems to be closely related to not only the genre of communication, but also to the *roles* of the interactants. A given person generally has multiple roles within a workgroup which bear on his or her interactions with group members. In a matrix managed organization such as the one studied in the first site, NPD, individuals have both organizational roles and titles as well as designated roles within particular projects.

Individuals also have roles related to personal relationships. For example, in many organizations a request made to one's supervisor to perform a non-routine task has very different force when made face-to-face than when made with a written memo. On the other hand, when one's supervisor makes the request, the channel choice implications are generally quite different.

Our emerging model of channel choice behavior requires a situationally based characterization of the interactants' roles and their attendant rights and obligations in interaction. The notion of *markedness* is useful in understanding the significance of channel choice in workgroup communication. When two (or more) alternative linguistic forms may occur in a given context, the occurrence of one form is often said to be unmarked whereas the occurrence of another is said to be marked. The unmarked form is in some sense the default, the one which "normally" occurs; occurrences of the marked form stand out or carry a special emphasis. In given contexts, use of a particular channel seems to be marked or unmarked in the same general way as other linguistic variations. Often channel choice and channel switching is marked with respect to the roles of the individuals involved. Looking again at the previous example, requests to perform a non-routine task tend to be marked when conveyed in writing from a person to his or her supervisor, but to be unmarked when made through face-to-face conversation.

In the following example, some of the flow of activity surrounding the NPD Mars project is seen and channel choice and channel switching behaviors are illustrated. Tasha, the Mars team leader, has been monitoring progress among team members as the Mars software is developed and tested. At 10:01 am she phones Fred, one of the software test engineers. Fred does not answer and so she immediately writes and sends an email message to him and to Tolly Bosch, another test engineer (note that the message header indicates the message was sent at 10:07:24):

> Senddone: 11/02/87, 10:07:24 < SEND Mon >
> To:freda@cyber,tollyb@cyber
> Cc:wilmak@cyber
> Fcc:Mars
> Subject: Mars test suite on tomato
> --------
> Any progress in building the Mars test suite for the 7140 and
> installing it on tomato? We are ready to use large portions of it
> for Mars testing.
>
> Also, what about 2_tst and 3_tst? Can you build them and put them
> on tomato? WHat do I need to know to run them?
>
> I noticed that I had missed putting in a userid on tomato for Tolly;
> I added you this morning. Sorry about that.
>
> I'd like to have a short meeting of Mars developers, possibly some time
> today, to discuss how we are going to test with "hercy" gone and
> the Hercules workstation delayed. The possibilities include testing to
> ourselves, using the PC as a client, and getting access to the IOPD

VAXes which have Mars (Herb is looking into that). At the same time
maybe you could give the rest of us an overview of how to run the
test suites and evaluate the results.

Thanks,
Tasha Larson

Immediately after sending the message to Fred and Tolly, Tasha composes and
sends a second email message announcing a meeting for 3 pm that afternoon.
Though it would have been possible to phone each of the meeting participants, she
chooses to use electronic mail as the channel for announcing the afternoon meeting.
This is an informed strategic choice on the part of Tasha. Electronic mail allows a
very quick distribution of information but, most important, it is a highly reliable
channel because all members of the Mars team are consistent users of the channel.

Senddone: 11/02/87, 10:13:41 < SEND Mon >
To:marsdev@cyber,herbj@cyber,freda@cyber,tollyb@cyber
Fcc:mars
Subject: meeting this afternoon at 3pm?

I'd like to have a meeting this afternoon (Monday) at 3pm in room 20.
Please let me know if you have a conflict.

The purpose is to discuss our immediate strategy for Mars testing,
including test equipment (the Hercules isn't here yet), test suites,
an informal bug tracking method, and setting priorities for bug
fixes so that we can move faster on testing.

I'd like to limit the meeting to people who are actually doing
testing right now so that we can not get sidetracked on to other
project issues - they can be handled in tomorrow's project meeting.

Thanks,
Tasha Larson

At 10:39 Tolly Bosch, arrives at Tasha's desk and states, "I got your email, and I
thought I would just talk to you rather than email." Tolly's comment highlights the
fact that his choice of face-to-face interaction is a marked case. Though expressed
casually, Tolly's comment belies the fact that in most cases technical discussions
which begin on one channel typically remain on the same channel. Among workers
in this environment, routine technical questions tend to be handled by electronic
mail. This is especially true when workers are not proximate to one another. They
discuss the testing issues for several minutes and conclude their conversation as
Tasha asks Tolly to find out if Fred has built the Mars test suites (Tolly and Fred
work together and have desks close to one another).

Ten minutes after Tolly leaves, Fred comes to Tasha's work area to discuss the
status of the main software development computer. It is not clear from the
conversation (transcribed below) that Fred received and read Tasha's earlier
messages, but Tasha quickly reiterates the content of the messages.

Fred: So...uh...then..what state is Tomato in and should I wait until it get's updated to the level of Kingpin before I try running any commands tests on it?

Tasha: Well I'm...I'm not...I'm not sure what's been done. Uh...Fred, have you built the Hercules test suite?

Fred: Have I built it? No.

Tasha: Ok...

Fred: I've seen it but I...

Tasha: ...And, have you...have you built any of the...like 2_tst or 3_tst or anything for Tomato? With any libraries?

Fred: No. I have only put commands on. That's all.

Tasha: Okay...um...I'm gonna...um... see if I can build em for...Now where's the Hercules test suite? I mean, did you have to make any mods? You built it on the Hercules right, or is it just Barbara has built it?

Fred: Uh...I think that Barbara's the only one.

Tasha: Barbara is the only one who's built it. Okay. I'll find out where that is...and want to get them on to...um...

Fred: Tomato?

Tasha: ...Tomato, but built with the MARS libraries.

Fred: Okay.

Tasha: Uh...I want to have a...I sent out some email. I'm going to have a meeting this afternoon, and we can all sit and talk about...you know...how are we going to do this? What do we test next, and what do we put in bin and what do we put in just our local directories and...

Fred: Right...

Tasha: ...Because right now we have non-MARS utilities in bin and etc.

Fred: This is not the one o'clock meeting you're talking about?

Tasha: hm?

Fred: When we get together? Or you're talking about our regular MARS meeting today?

47

Tasha: No. I want to have one just for developers, people who are actually working on code and testing right now.

Fred: Okay

Tasha: Cause I think it will go quicker if we do that separate from regular MARS meetings, so I sent out some email to see if anybody's free at 3:00 this afternoon.

Fred: Oh, I see...ok...yeah...right

Tasha: And we can sit down and talk about the test suite...

Fred: So I should just hold off until then or? I mean I wanted to do...

Tasha: You can log on there and try some stuff...

An additional example is interesting in that it highlights some of the intrinsic features of different channels. In this case, the subject chooses to send a meeting announcement via email. This choice is shaped by the lateness of the hour and thus urgency of the message, as well as the subjects knowledge that email is ubiquitous in this setting and his chances of reaching the necessary parties are increased by using this channel. Still, the use of the channel provides additional problems. In this case the author must address the inherent ambiguities of asynchronous channels. In the following piece of email, the author is scheduling a meeting for the next day. He has chosen to use a medium for communication which provides for the asynchronous transfer of the message. The message concerns a meeting set for early the next day but is sent at approximately 5:30 pm, too late to reach most of the recipients since they will have gone home by that time. The text of the message indicates he anticipates the readers will receive the message the next day, and so he attempts to clarify the day of the meeting as "today.. Tuesday" even though he wrote and emailed the message on Monday.

Senddone: 12/14/87, 17:30:53 < SEND Mon >
To : rodm@penguin, karla@paranoid, bobm@salute
Cc : gails@robustus, geoffg@hero, timb@druid
Fcc:outbox
Subject: Norfolk Contingency PLan

As we discussed, we need to put together a plan in case
Norfolk cannot provide us with chips on time.

Gail suggested that before we do too much we get the ground rules
crystal clear from our management before we start. I intend to get
either Ron Joyce who is out of town this week) or Rick Jones'
approval of our decision making
criteria before we go and generate a lot of external communication.
This needs to happen ASAP, but needs to be this week.

To that end please come to a meeting tomorrow (actually today.. Tuesday)
at 8:30 in room 20, the purpose being to develop
a prioritized criteria list that we will present to Rick Jones for
approval.

See you there.

Bari

There are also contexts in which varying channel choices do not reflect differences in their markedness or appropriateness with respect to workgroup communication patterns. In such cases we observed very pronounced individual differences among workgroup members' channel choice behavior. We call these variations individual channel *preferences*. In situations where both face-to-face and electronic mail are appropriate to workgroup communications, for example, one individual may prefer to use electronic mail, whereas another prefers face-to-face. They seem to be part and parcel of an individual's *communicative style*.

Our research in NPD indicates that there are wide qualitative differences among individuals in terms of channel preferences and communicative style. The sub-group of Nova software engineers mentioned above clearly preferred electronic mail over other channels for their ongoing communications. The Nova project manager, on the other hand, came to the project with a background in another Division where electronic mail was little used. Over a period of several months, however, he became proficient with the system and used it very effectively to communicate with project staff. Though he claimed that he was more comfortable with face-to-face or telephone interactions, his role and the nature of the existing communicative styles of the project staff required he adjust his communication preferences.

5.0 RESULTS OF THE SHADOWING STUDY: SITE 1

This chapter presents the results of the shadowing study of the two Io Products Corporation workgroups described in previous chapters: the Component and Integration teams. The shadowing data, of course, can be aggregated, averaged and presented at several levels: at the *session* level (i.e., for a particular day on which a given individual was shadowed); at the *individual* level (i.e., data are aggregated and/or averaged over all sessions during which a given individual was shadowed); at the *workgroup* level (i.e., data are aggregated/averaged over all sessions during which workgroup members were shadowed); and at the *overall* level (i.e., data are aggregated/averaged over all shadowing sessions).

For most analyses, data are presented at both the *workgroup* and *overall* levels of aggregation. To maintain the anonymity of the individuals who participated in the shadowing, individual level data are presented only when they are essential to an analysis; in those few instances when individual level data are presented, individual identifiers are never presented.

5.1 Time and Activities at and Away from Desk

Individuals were shadowed both while they were at their desks and away from their desks. Overall, individuals were in the proximity of their desks[1] for 69.4% of the time they were shadowed (216.07 out of 311.32 hours[2]). Figure 5.1 displays the variation of the percentage of "desk-time" by workgroup[3].

Members of the Component and Integration Teams spend, on the average, 72.3% and 67.9% of their time in the proximity of their desks, respectively. Although these group averages are relatively close, there is wide variation among individuals' percentage of "desk time", depending primarily on the extent of engagement in meetings in other offices or conference rooms. Overall, about 2/3 of time away from one's desk is spent in meetings, chiefly at others' desks, at work areas or in conference rooms.

5.2 Basic Activity Measures

Two descriptive measures of activity in a day are the number of distinct tasks[4] in which a person is engaged and the number of distinct individuals with whom a person interacts. These measures each tend to increase substantially on workdays perceived as "busy" and tend to decrease markedly on workdays perceived as being relatively "quiet." Figures 5.2 and 5.3, respectively, display the averages of these measures on a per day basis for members of the two workgroups.

---

[1] For the purposes of this analysis, an individual was classified as being "at desk" while observed in his or her cubicle or office.

[2] Fractions of hours are expressed throughout this report as decimal quantities rather than minutes and seconds, so that 3.50 hours represents 3 hours and thirty minutes rather than three hours and 50 minutes.

[3] Each time a figure is presented in the text, corresponding numerical quantities are tabled (with a number corresponding to the figure) in Appendix A, e.g., Table 5.1 in Appendix A lists the hours at desk for each of the workgroups, corresponding to Figure 5.1.

[4] See Chapter 3 for definition and coding of distinct tasks.

% of time
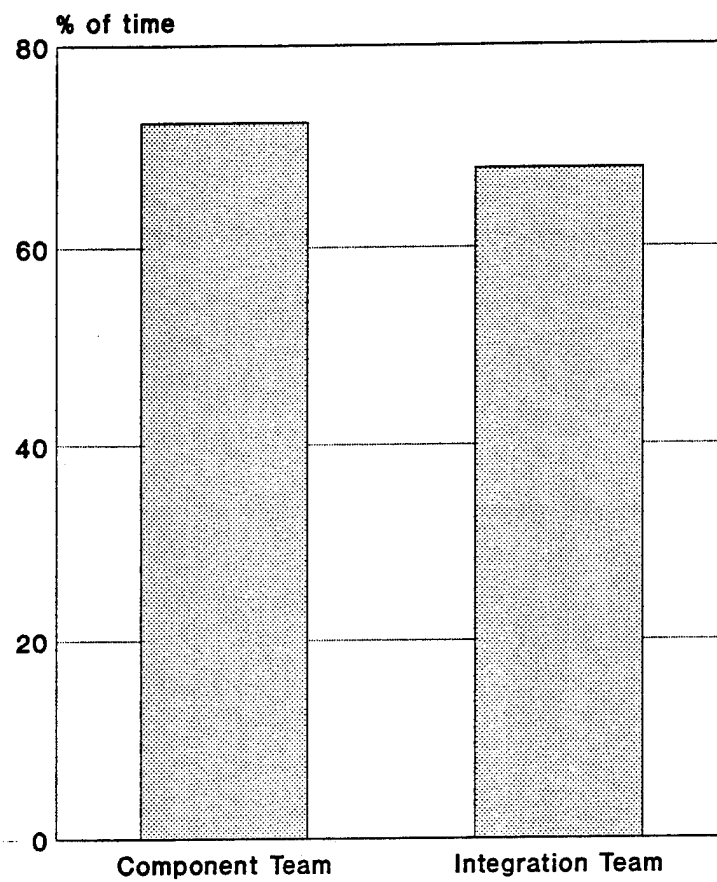
Note: For days in office

Figure 5.1   Time Spent in Proximity of Desk

51
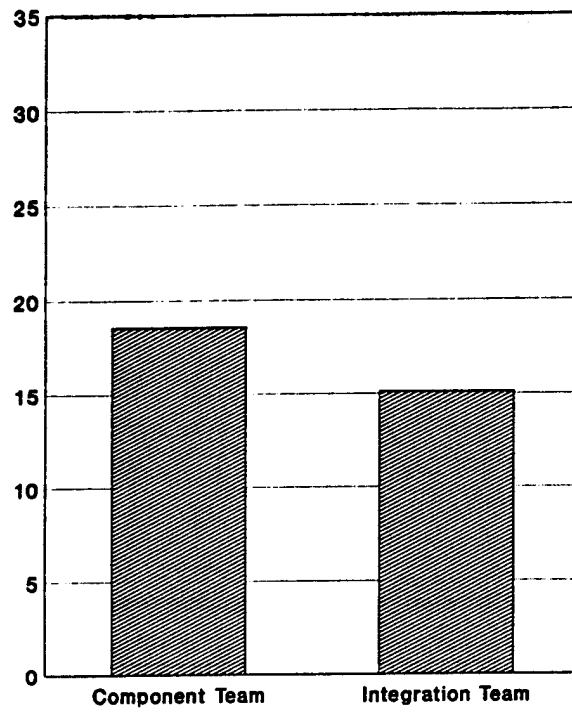
Figure 5.2   Tasks per Day
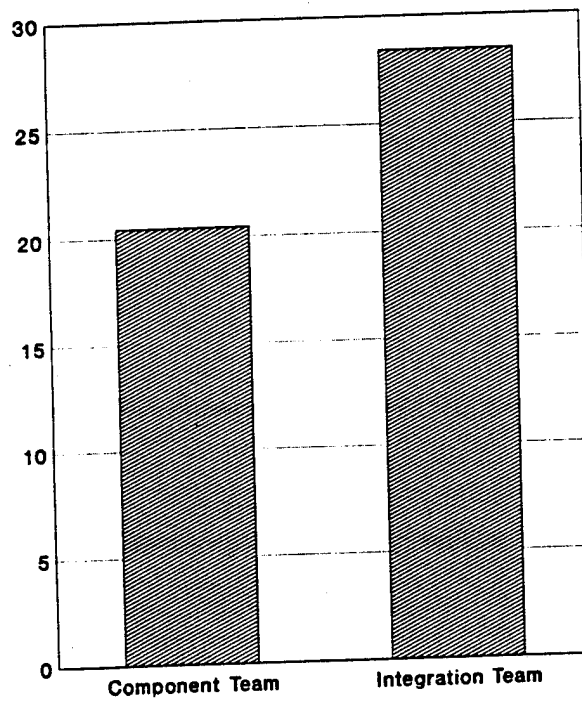
Figure 5.3   Distinct Interactants per Day

5.2.1 Tasks per day. In Figure 5.2, we see that members of the Component Team are engaged in somewhat more tasks per day than members of the Integration workgroup. Indeed, the Senior Team members average about twice as many tasks per day as members of the other workgroups.

5.2.2 Interactants per day. Figure 5.3 illustrates the number of distinct interactants per day with whom workgroup members interact. This is an *unduplicated* count of the individuals with whom group members met face-to-face, talked on the telephone, received a letter from or sent a letter to, and so forth. If a person attended a meeting with four individuals first thing in the morning, the count would be increased by four; if that person talked on the phone with one of those individuals later in the day, the unduplicated count would not increase.

Members of the Integration group on the average interact with more individuals per day than do members of the other groups. In section 5.5 below, some related measures of breadth of interactional or contact networks for these workgroups will be considered.

5.2.3 Relationship between the two measures. The observed group differences between the teams' average number of tasks and interactants per day are easier to interpret as individual data. In Figure 5.4, individuals' average number of tasks per day are plotted against their average number of distinct interactants per day. Each point in the scatter plot is an individual member of one of the three workgroups. The groups are plotted with distinct symbols. Although the shape of the scattergram indicates a positive correlation between these two measures of an individual's activity, the figure also indicates that the two measures are substantially independent; for a given number of tasks per day, there is quite a range of number of interactants per day, and vice versa. Intuitively this makes sense; an individual may be busy in terms of number of tasks or in terms of number of interactants, or both.

There are two outlying points or individuals in these data; each "outlier" is an individual who has a managerial role within the Integration Team, with the overall project manager being the extreme outlier. Other than these two individuals, members of the Component Team are generally distinguished from members of the Integration team by having more tasks (but about the same number of interactants) per day. We shall see this pattern recur through a number of analyses below: Individuals in managerial roles stand out in these quantitative analyses, more than overall differences among the workgroups themselves.

5.3 Work Activities

In this section, the examination of the microstructure of time and activity begins. Parallel sets of data will be scrutinized which pertain to three aspects of the fine temporal structure of activity: the number of observed episodes comprising an activity, the aggregate time across the episodes constituting an activity, and the mean duration of those constituent episodes. Although these three ways of assessing time are closely interconnected, they offer somewhat distinct perspectives on the fine temporal organization of activity.

Figures 5.5, 5.6 and 5.7 display, in data aggregated across workgroups, the distribution of work activities into five categories: solitary work, face-to-face, telephone, electronic mail and written/hardcopy communication. Figure 5.5 displays the percentage of episodes falling into each of these categories, whereas
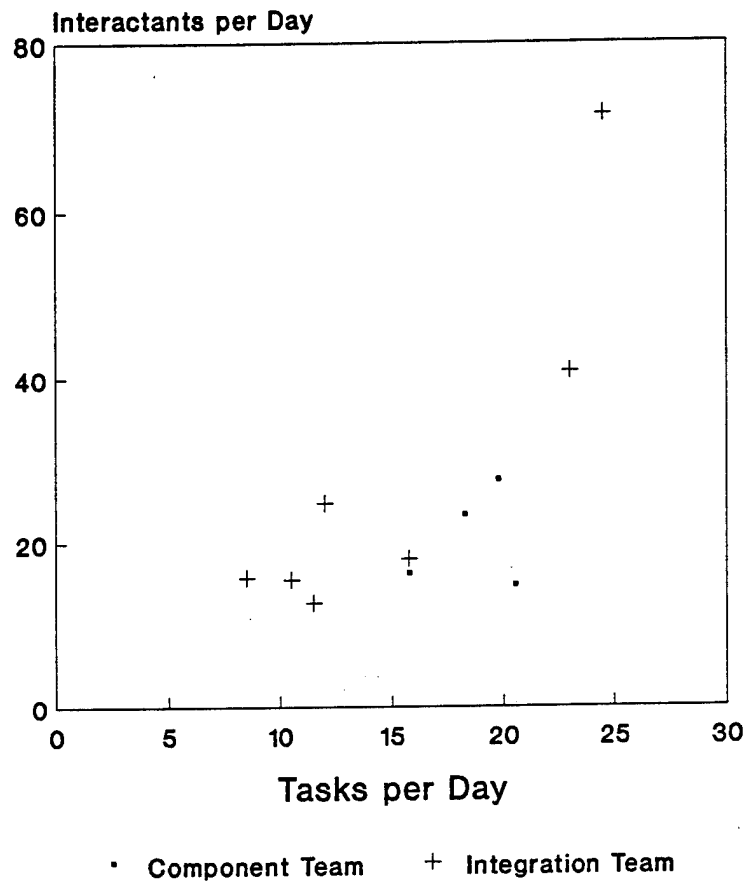
53

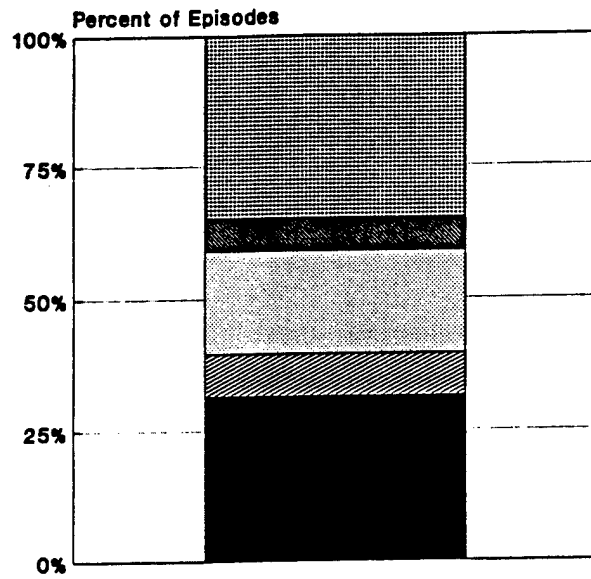Figure 5.4   Scatter Plot of Tasks/Day x Interactants/Day

Figure 5.5   Work Activities: Episode Distribution
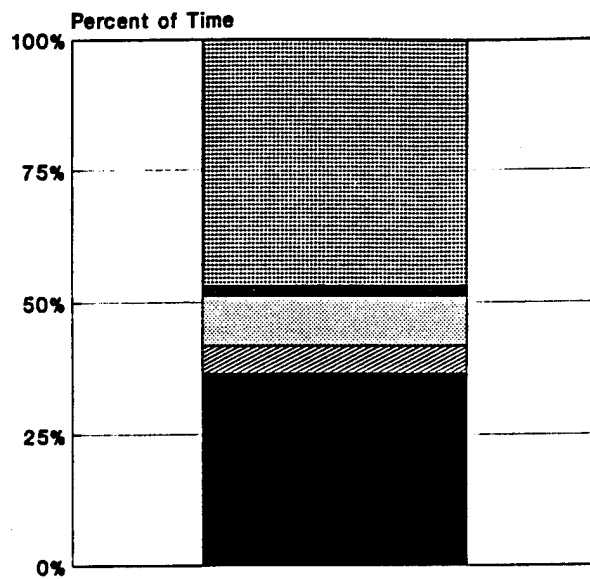

Figure 5.6   Work Activities: Time Distribution
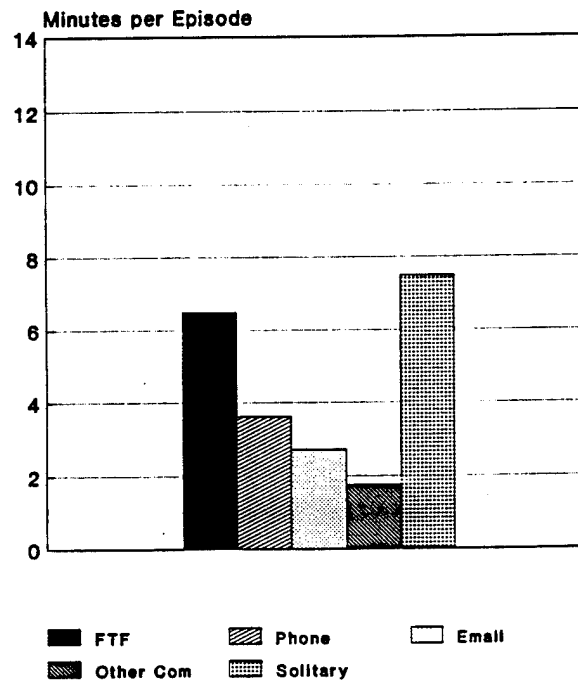
Figure 5.7   Episode Duration of Work Activities

Figure 5.6 shows the corresponding distribution in terms of percentage of time. Figure 5.7 shows the mean duration (in minutes) for episodes in these four activity categories. These analyses are based on 3246 simple and compound episodes; 75 compound episodes were necessarily excluded from these analyses because they involved a mixture of two or more of these activity types[5].

5.3.1 Overall distributions of activity. Figure 5.5 indicates that, overall, about 35% of the episodes are solitary work, 32% are face-to-face interaction, 19% electronic mail, 8% telephone, and remaining 6% hardcopy. Thus about two-thirds of the episodes involve either face-to-face interaction or solitary work.

This picture changes substantially in Figure 5.6, which displays the distribution of aggregate time encompassed by the episodes. Differences among the activity categories persist, but, in terms of time, are rescaled from their episode distribution. The percentage of solitary work (top section) jumps from 35% of episodes to 47% of time; the percentage of face-to-face interactions increases from 32% to 37%; but the percentages of time spent in other channels (phone, email, and hardcopy) "shrinks" from the corresponding percentages of episodes. Nearly 84% of time is spent in solitary work and face-to-face interaction.

The relationship between the episode and time distributions is further clarified in Figure 5.7, which shows the mean duration of each type of episode. Episodes of solitary work average 7.5 minutes in duration, about a minute longer than the average episode of face-to-face interaction (6.49 minutes). Episodes in other channels have substantially shorter average durations (under 4 minutes) as seen in the figure.

As we continue to use these temporal measures to look more closely at the structure of activities, it is important to keep in mind the overall relationships among these measures, and to remember that any two of the distributions determines the third. In general, as we go through the data, we will find the time distributions the most useful of the three. In most cases, however, the three parallel measures will be presented together.

5.3.2 Distributions across workgroups. Figures 5.8, 5.9 and 5.10 break down the data considered in the previous section for the two workgroups. Some relatively minor differences between the workgroups can be seen in these figures. In terms of the episode distribution (Figure 5.8), the Component team uses relatively more face-to-face interaction and relatively less telephone than the Integration team, whereas the percentage of episodes in solitary work and in other communication channels appear to be about the same. These relatively minor differences disappear when the corresponding time distributions are compared, as shown in Figure 5.9. Although the Component team spends somewhat more time in email communication and somewhat less time in telephone communication than the Integration team, the major temporal categories of activity (face-to-face interaction and solitary work) are equivalent across the two groups. In particular, the percentage of time spent in communication as opposed to solitary work activities, which can be read at the bottom of the dotted section at the top of each group's distribution, is about the same: 52.6% and 53.4% for the Component and Integration teams, respectively.

---

5 The 75 compound episodes excluded from these particular analyses comprise 2.3% of all observed episodes and 2.7% of all observed time.

Figure 5.8   Workgroup Activities: Episode Distribution
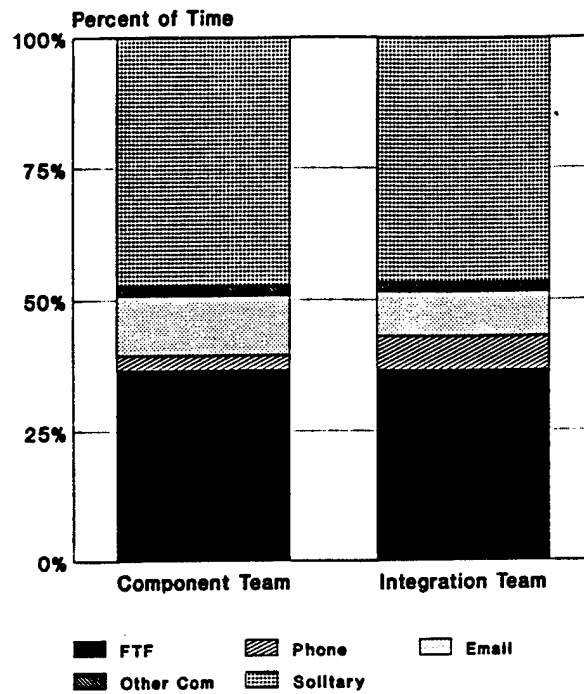
Figure 5.9   Workgroup Activities: Time Distribution

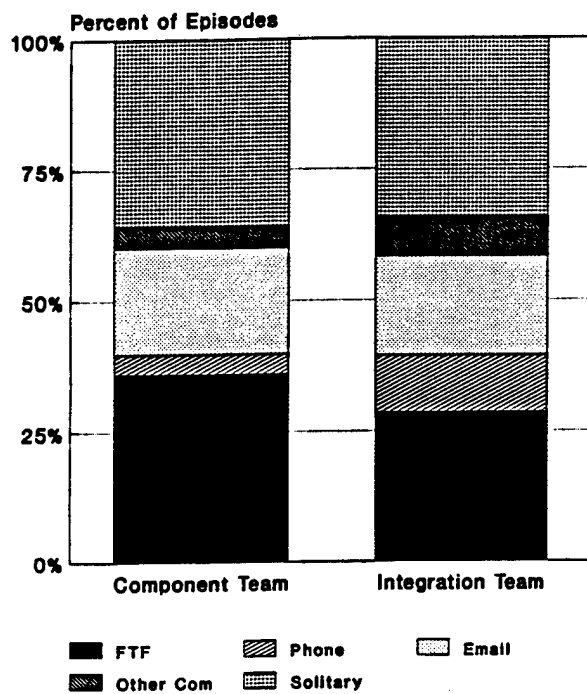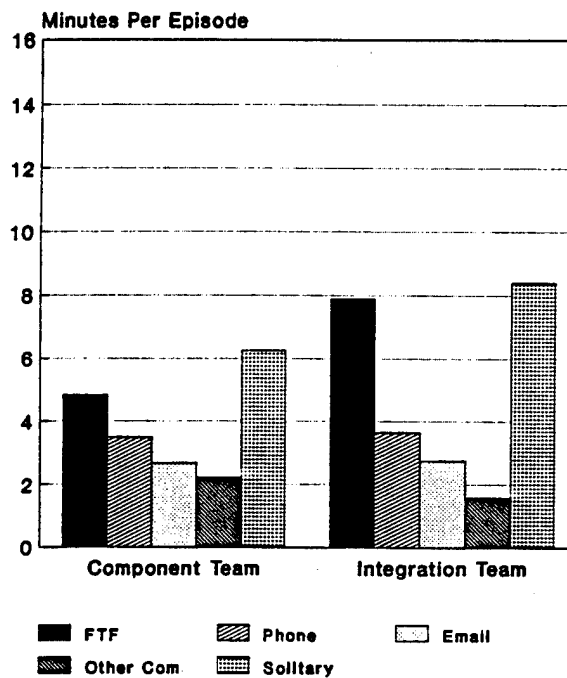Figure 5.10   Workgroup Activities: Episode Duration

In Figure 5.10, the mean duration of episodes for the various activities are plotted for the two workgroups. The general shape of the distributions is similar in each group, and average durations are about the same over the two groups for telephone, email and other communication channels. But average durations appear to be somewhat longer for the Integration team's episodes of solitary work and face-to-face interaction.

<u>5.3.3 Individual distributions.</u> Although there are some overall group-level differences between the two teams' activity distributions, these are group averages of individual level data. As discussed in previous chapters, there were wide qualitative differences observed among individuals in terms of work style, role within the team and preferred communication patterns. Many of these individual differences are evident in Figure 5.11, in which the time distributions for individuals are displayed. The individual time distributions shown in the figure are arranged by workgroup.

In contrast to the group-level data, there are obvious and profound individual differences evident in these data. The major differences are among individuals' percentages of time spent in solitary work, face-to-face conversation and electronic mail. The dotted section at the top of each distribution represents time spent in solitary activity, and varies from as much as 64% to as little as 18% of an individual's time. Conversely, the dark solid section at the bottom of each bar represents time spent in face-to-face interaction, and varies from as little as 14% to as much as 61% of an individual's work activities.

These individual differences are closely related to the nature of the individual's work and role within the team. The three individuals with the highest proportion of face-to-face time are the ones with the lowest proportion of time in solitary work; these are the three individuals who have managerial responsibilities within their teams (the individual displayed at the far left of the Component group and the two individuals shown at the far left of the Integration team in the figure).

The amount of time spent individuals spend in communication (which includes all but the solitary work categories) can be read at the bottom of the dotted sections at the top of each distribution in Figure 5.11. In contrast to the lack of an overall group difference, there is wide individual variation here in the percentage of work time spent in communication, ranging from as little as 36% to as much as 82%. The three individuals with supervisory roles within their groups spent between 71-82% of their time communicating, whereas no other individual spent more than 53% communicating.

<u>5.4 Channel Usage</u>

In the previous section, the distribution of work activities into solitary work and communication categories was considered. In this section, we will look more closely at the communication channels which individuals use to accomplish the communicative part of their work. Channels used include face-to-face, telephone, electronic mail and hardcopy. The contrasting channel categories for the following analyses then, are *face-to-face, phone, hardcopy* and *email*.

The set of data examined in this section is drawn from *single-channel episodes*, i.e., simple episodes (which by definition can involve at most one channel) and compound episodes which, although they may compound multiple tasks, involve only a single channel. The data set to be examined here is the subset of "2110"
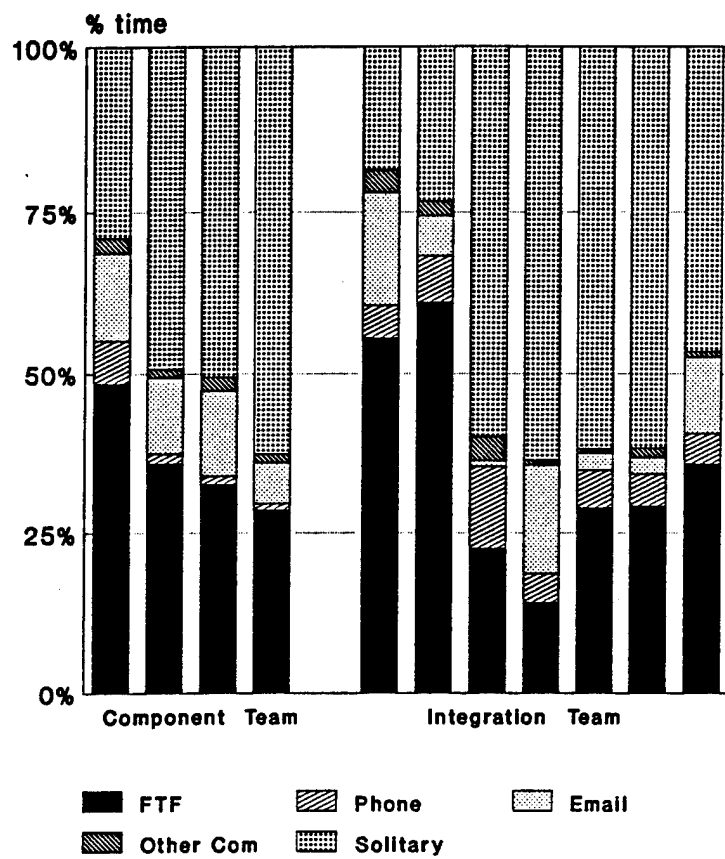
Figure 5.11　Individual Work Activities

episodes consisting entirely of communicative task events and involving only a single channel.

5.4.1 Overall distributions. Figures 5.12, 5.13 and 5.14 display the episode, time and duration data for the overall population of individuals shadowed. The episode distribution (Figure 5.12) shows a preponderance of face-to-face conversation and email episodes; the time distribution (Figure 5.13) shows a preponderance of time is spent in face-to-face, about 69% of communication time. The use of non face-to-face other channels accounts for larger proportions of the episode distribution than of the time distribution[6]. The mean durations for episodes of communication in these channels are displayed in Figure 5.14. The mean duration of face-to-face episodes is about 6 minutes, compared to mean durations of 2-4 minutes per episode for the other channels. (This compares with Sproull's (1984) average duration of about 12 minutes for face-to-face conversations, but her individuals spend more time in multi-person meetings.)

5.4.2 Distributions across workgroups. These data are cross-tabulated by workgroup in Figures 5.15, 5.16 and 5.17, respectively. Overall group differences noticeable in the episode distributions (Figure 5.15) are less conspicuous in the time distributions (Figure 5.16). Mean episode durations are exhibited in Figure 5.15. Face-to-face interactions have longer average durations in the Integration group reflecting a higher mix of staff meetings. Telephone, electronic mail and hardcopy communication episodes appear to have similar patterns of average duration in the two groups.

5.5 Breadth of Interaction

The number of distinct interactants per day was considered in section 5.2.2 as a basic measure of individual activity. In this section, the measure is extended in several ways to examine the breadth of interaction of the workgroups (i.e., an unduplicated count of the individuals with whom someone interacted over the course of their observed activities). This measure can be computed for interactions as a whole, or independently calculated for each channel through which interactions occurred (e.g., face-to-face conversation, telephone, etc.).

5.5.1 Breadth of interaction by channel. Figure 5.18 displays the unduplicated counts of interactants enumerated for observed interactions through face-to-face, telephone, email and hardcopy. These unduplicated counts are computed for the eleven shadowed individuals as a whole. The unduplicated combined count for all channels is also shown in the figure to the left as the dark bar. The fact that the unduplicated count for all channels is substantially higher is a measure of the *non-overlap* among the interaction networks of these channels. If there were perfect overlap among the interaction networks of these channels, then the all-channel count would be no larger than the largest count for any one channel.

Notice that face-to-face interaction is the broadest single channel, with slightly more than 150 different interactants. But email is a very close second, again suggesting

---

[6] It is important to note again, as explained in Chapter 3, that observers distinguished between direct communication in a channel such as hardcopy — in which, for example, a letter was composed or read as it was received — and non-communicative uses of the channel, e.g., reviewing a previously read/filed report or letter. Although this is somewhat of an artificial distinction for asynchronous communication channels such as electronic mail and hardcopy, experiments with the operational definition in our data analyses did not interact with the major findings.

Percent of episodes

Face to Face   Phone
Hardcopy   Email
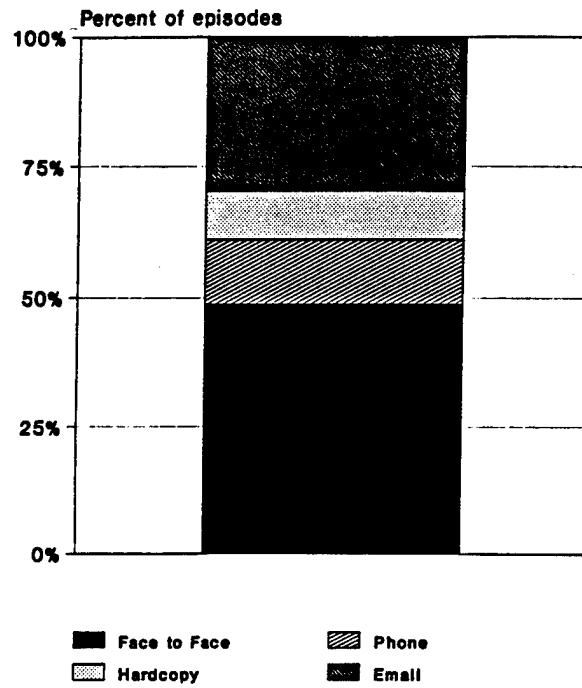
Communicative episodes (N=2110)

Figure 5.12   Episode Distribution of Communication

Percent of time

Face to Face   Phone
Hardcopy   Email

Communicative episodes (N=2013)

Figure 5.13   Time Distribution of Communication

Minutes

Face to Face   Phone
Hardcopy   Email

Communicative episodes (N=2013)

Figure 5.14   Episode Duration of Communication

61

Figure 5.15   Workgroup Communication: Episode Distribution

Figure 5.16   Workgroup Communication: Time Distribution
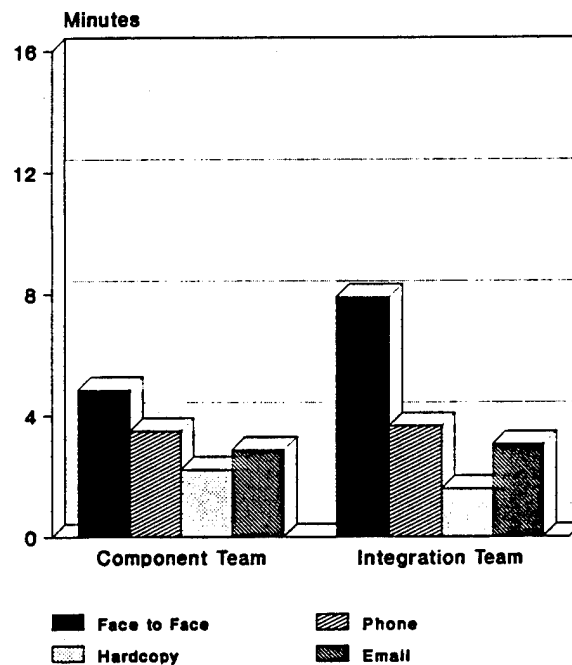
Figure 5.17   Workgroup Communication: Episode Duration
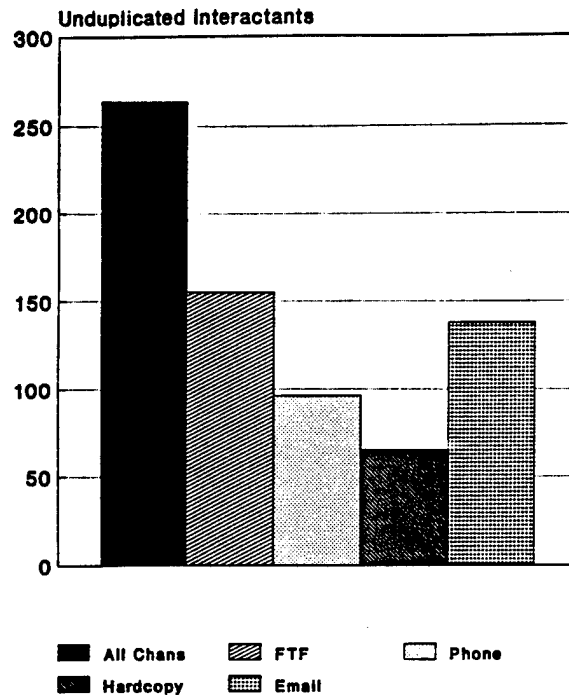
Figure 5.18   Breadth of Interaction
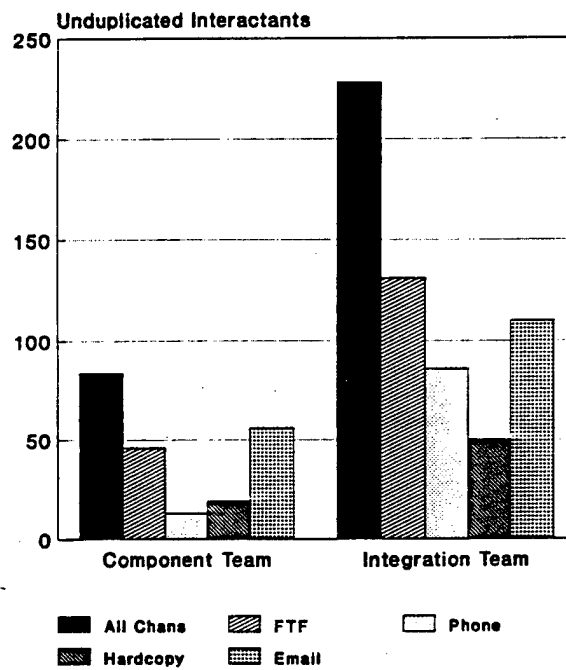
Figure 5.19   Breadth of Interaction in the Workgroups

63

the extent of its utilization in this work setting. Telephone and hardcopy are ranked third and fourth in terms of interactional breadth.

5.5.2 Breadth of interaction for individual workgroups. Unduplicated interactions were enumerated in this way separately for each of the two studied workgroups. The results are displayed in Figure 5.19. Although the Integration team appears in these data to have a broader network of interactants than the Component workgroup has, care must be taken in comparing the groups in this way because these are workgroup aggregations rather than the individual-averaged data that we have usually presented, and varying numbers of individuals were shadowed from each group. But not all of the group differences evident here can be dismissed for this reason. The workgroup averages of the corresponding per-day measures of interaction breadth were presented earlier, and a substantial workgroup difference appeared (cf Figure 5.3).

Returning to Figure 5.19, not only do the groups apparently differ in terms of overall breadth of interaction (Figure 5.3), but also in terms of how they use the alternative channels in realizing that breadth. Face-to-face and email are the broadest channels for each group, with email slightly broader than face-to-face for the Component team, and vice-versa for the Integration team. Telephone usage is relatively broad for the Integration team (nearly as broad as face-to-face interaction), whereas it is relatively insignificant for the Component team (and, in fact, narrower than even the hardcopy channel).

The point to be taken from these data is that individuals and workgroups access distinct interactional networks through the various communication channels at their disposal; the networks accessed through the various channels have different interactional extents (with face-to-face and email being the broadest for these groups, followed by telephone and hardcopy). There is partial but far from complete overlap among the interactional networks associated with the various channels. Some of the differences between the groups' channel utilization patterns will be easier to interpret after the communication is crosstabulated by the organizational relationship of the interactants (e.g., are they members of the same workgroup?). This is taken up in the next section.

5.6 Organizational Communication

Having considered some of the temporal properties of using the various communication channels (section 5.4) as well as the breadth of interaction associated with those channels (section 5.5), we now look in greater detail at the nature of these communication patterns from an organizational perspective. The analyses which follow are derived from an underlying matrix of interactions between the persons shadowed and those with whom they interacted. These pairwise interactions between shadowees and their interactants were cross-tabulated into a 2 x 4 x 4 matrix: shadowee's workgroup x interactant's organizational status x communication channel. Four distinctions were made among the organizational status of the interactant with respect to the shadowee: same workgroup, same division (but not same workgroup), same company (but not same division) and external (customer, business partner, etc.). Four categories of channels were distinguished in these analyses: face-to-face, telephone, hardcopy, and email.

Interactions between the shadowee and a given person were counted on a *per episode* basis. Thus, if the shadowee met with a person and discussed three topics during the meeting, only 1 interaction would be counted (although three tasks may

have comprised the compound episode). If, on the other hand, the shadowee discussed a topic with four other persons during a meeting, four separate interactions, each between the shadowee and one of the other participants, would have been counted. If the shadowee later met privately with one of the participants, an additional interaction would be counted. In all, 2671 interactions were classified and counted in this manner[7].

The raw frequencies of interaction are displayed in a 2 x 4 x 4 table in Appendix B. The figures presented in this section (and the like-numbered tables in Appendix A) are all derived from this basic matrix of interaction frequencies[8].

5.6.1 Communication between workgroups and other organizational units. Figure 5.20 displays the percentage of each workgroup's communication with individuals at varying organizational "distances." There are several points of overall similarity between the two groups' patterns shown in the figure. Less than half of each group's communications are among themselves. The plurality (and, for the Integration team, the majority) of communications are with others in their division. Given the highly matrixed nature of the division's staffing and the strategic role of the team's products within the division's activities, this is probably not surprising in itself.

5.6.2 Channel usage patterns in organizational communication. The distribution of communication (in terms of percentage of interactions) across organizational levels for each of the four channels is displayed in Figure 5.21. Interactions through each channel are counted for each of the four types of organizational communication: intra-group, intra-division, intra-company and external. As seen for the overall data in the previous section, most of the interactions within each channel are at the intra-division level, that is, with members of the same division other than the immediate workgroup. Striking in these figures is the fact that the percentage of communication in each channel that is intra-divisional is constant across channels whereas the patterning of other interactional categories varies across channels.

The face-to-face channel is used extensively for the organizationally-closest communications, those within the immediate workgroup or division. Hardly any of the face-to-face or email communication serves organizationally distant communication, i.e., with individuals outside of the division or company (although some of those infrequent face-to-face contacts may be very important). The telephone and hardcopy channels on the other hand, seem to serve all organizational distances of communication in a relatively balanced way. Interestingly, the organizational pattering of face-to-face and email usage are similar (and specialized to organizationally proximal interactions). We shall discuss this further below after examining other relationships in this database.

5.6.3 Workgroup-specific patterns of channel usage in organizational communication. Some strong similarities between the two workgroups are evident in Figure 5.22, in which each workgroup's channel usage pattern is displayed for each of the four categories of organizational communication: intra-group (Figure 5.22a), intra-division (Figure 5.22b), intra-company (Figure 5.22c) and external (Figure 5.22d). Only in the case of external communication (Figure 5.22d) is there a

---

[7] A few observed interactions were excluded from this analysis because the identity or organizational status of the interactants could not be determined.

[8] Duration data from these interactions were not used in these analyses because of the difficulty of allocating "time" to pairwise interactions when more than two persons interact (as is often the case in meetings or electronic mail and hardcopy sent to multiple recipients.

Percent of interactions
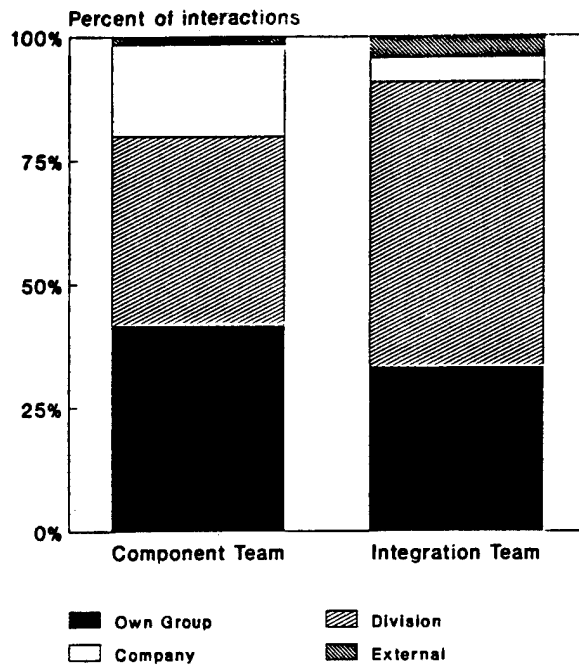
(N=2671)

Figure 5.20   Organizational Communication by Group

Percent of interactions
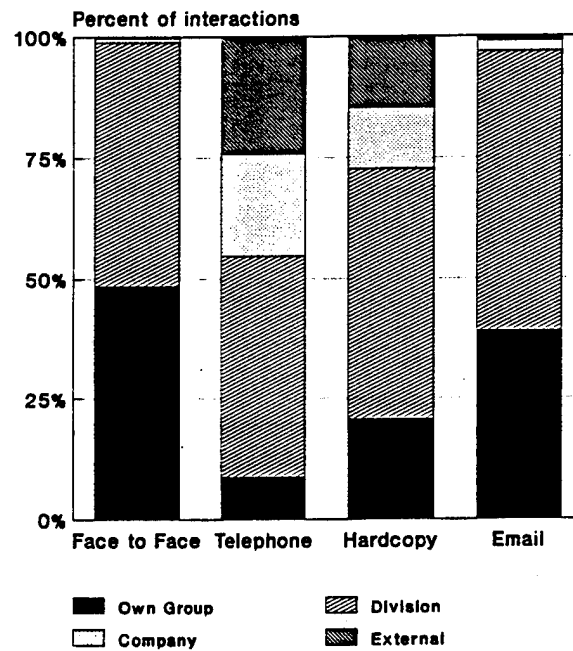
(N=2671)

Figure 5.21   Organizational Communication by Channel
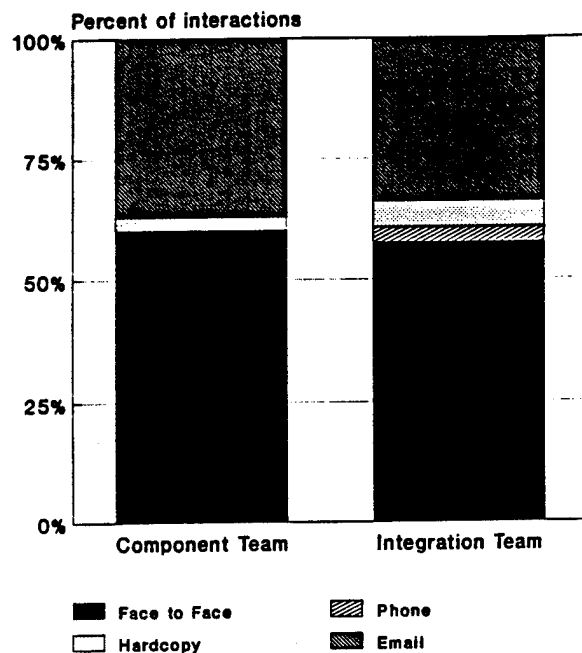
Figure 5.22a

(N=1068)

Channel Usage in Organizational Communication: Intra-Group
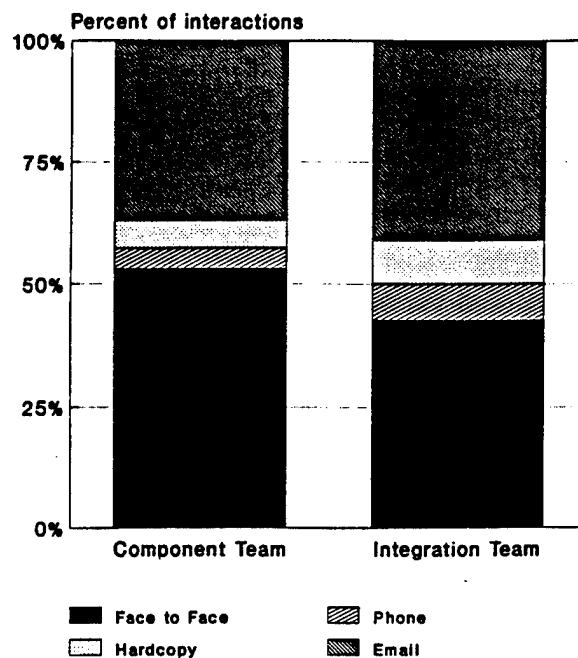
Figure 5.22b

(N=1412)

Channel Usage in Organizational Communication: Intra-Division
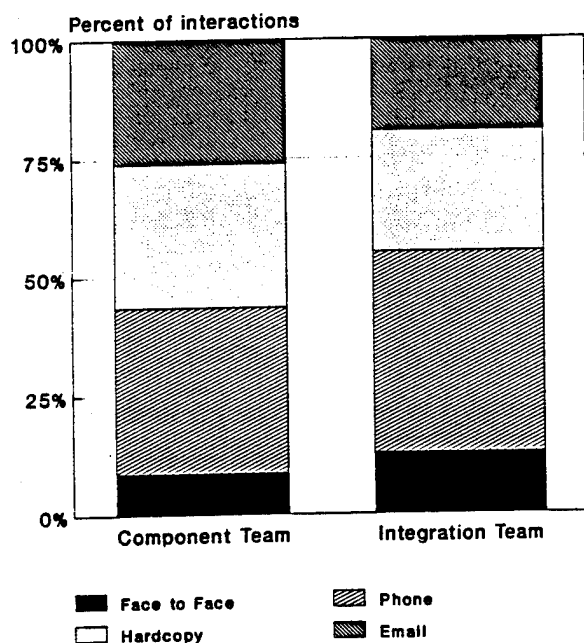
Figure 5.22c

(N=101)

Channel Usage in Organizational Communication: Intra-Company
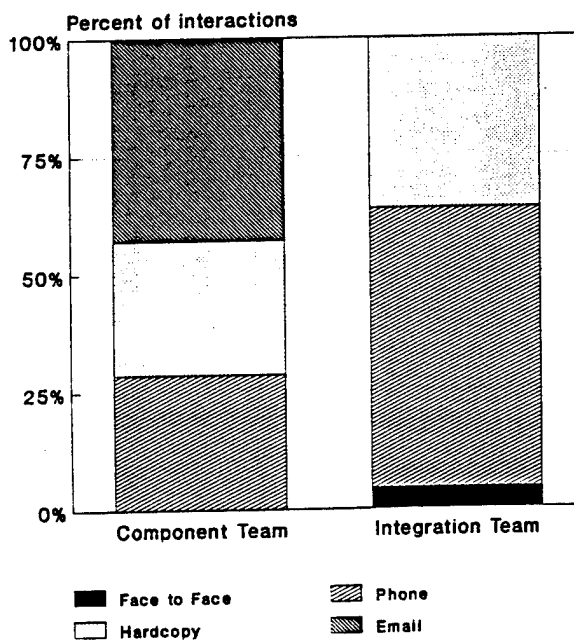
Figure 5.22d

(N=90)

Channel Usage in Organizational Communication: External

67

suggestion of a group difference; the Component team use email primarily for external communications whereas the Integration team uses telephone. This is primarily due to the fact that the external interactants of the Integration team, (primarily business partners and customers) do not use email, whereas the external interactants of the Component team (technical counterparts in other engineering organizations) are regular email users.

Focusing now on the three categories of internal communication (Figures 5.22a, b, c), the similarity between the two groups profiles is quite striking. Face-to-face and email are clearly the primary channels for intra-group and intra-division communication. Each group mixes roughly equal percentages of face-to-face and email communication, with secondary amounts of hardcopy and telephone channels. More organizationally distant communication (Figure 5.22c) exhibits a more balanced mix of the four channels. In each workgroup, the three other channels have surpassed the frequency of face-to-face communication.

5.6.4 Workgroup communication patterns. Figure 5.23 displays another view of the two workgroups' channel usage patters used to meet their communication needs. Parallel displays are shown for the Component (Figure 5.23a) and Integration (Figure 5.23b) workgroups. The two workgroups exhibit relatively similar patterns of channel usage as they conduct their communicative activities. Both face-to-face and email (but hardly any telephone or hardcopy) are used for intra-group communication among these geographically collocated groups.

5.6.5 Trends in channel usage. In Figure 5.24, data from the two workgroups are again pooled to exhibit how the various channels are deployed to communicate with individuals at varying organizational distance. As we move from left to right across the three leftmost bars in the figure (from Own Group to Division to Company to External), we see several orderly trends, aspects of which appeared in some of the previous figures. First, there is a systematic decrease in the reliance on face-to-face and email communication. Second, there is a corresponding increase in the use of hardcopy and telephone. As before, there is a fairly regular tradeoff here between use of, on one hand, face-to-face and email, and on the other hand, hard copy and telephone. As seen in Section 5.5, for the breadth of interaction data, similarities again emerge here, between face to-face and email, on one hand and telephone and hardcopy on the other hand.

It is of considerable theoretical interest that face-to-face and email usage exhibits one organizational distribution whereas telephone and hardcopy exhibit another. In each case, we have a synchronous and an asynchronous channel displaying a parallel pattern (e.g., face-to-face, a synchronous channel, and email, an asynchronous channel). One possibility is that certain kinds of communication are preferably conducted through the most interactive (i.e., conversational or "rich") channels available or logistically practical in the given situation. In such circumstances, face-to-face is preferred when its use is practical, but telephone (the next most interactive or "rich" channel available) is used when face-to-face conversation is not practiced. This might explain at least some of the tradeoff between face-to-face and telephone that's evident in the data. The parallel tradeoff observed between email and hardcopy could be generated in a similar way when the nature of the communicative task favors the use of text (email or hardcopy) rather than voice: If the recipient has access to email, its use is preferred, because it is quicker to transmit over distance than hardcopy (remember, fax was not yet commonly used in this environment!), or because it is easier for individuals to incorporate into their computer-based work, etc. The fact that interactants outside of the division and

Percent of interactions
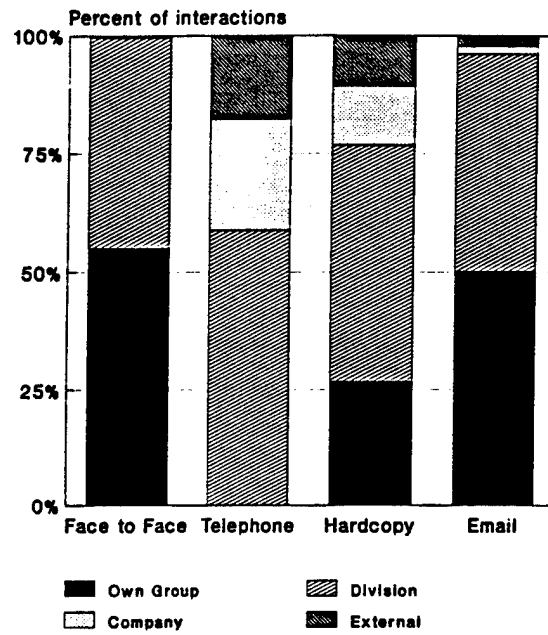
Figure 5.23a Organizational Communication: Component Team

Percent of interactions

Figure 5.23b Organizational Communication: Integration Team

Percent of interactions by channel

Organizational status of interactant

Face to Face   Telephone
Hardcopy   Email
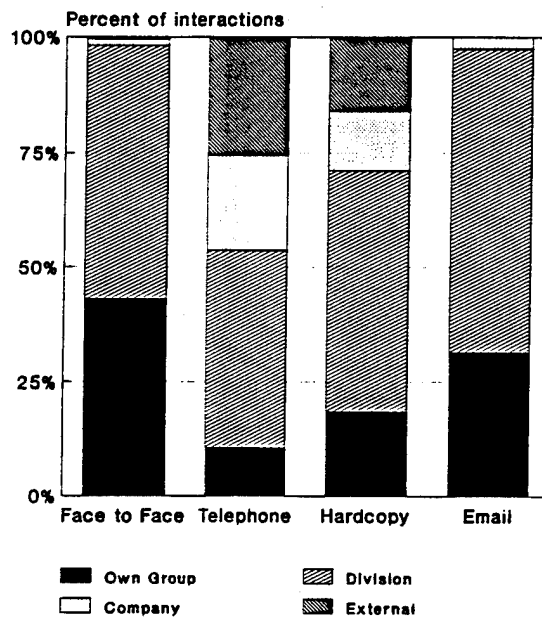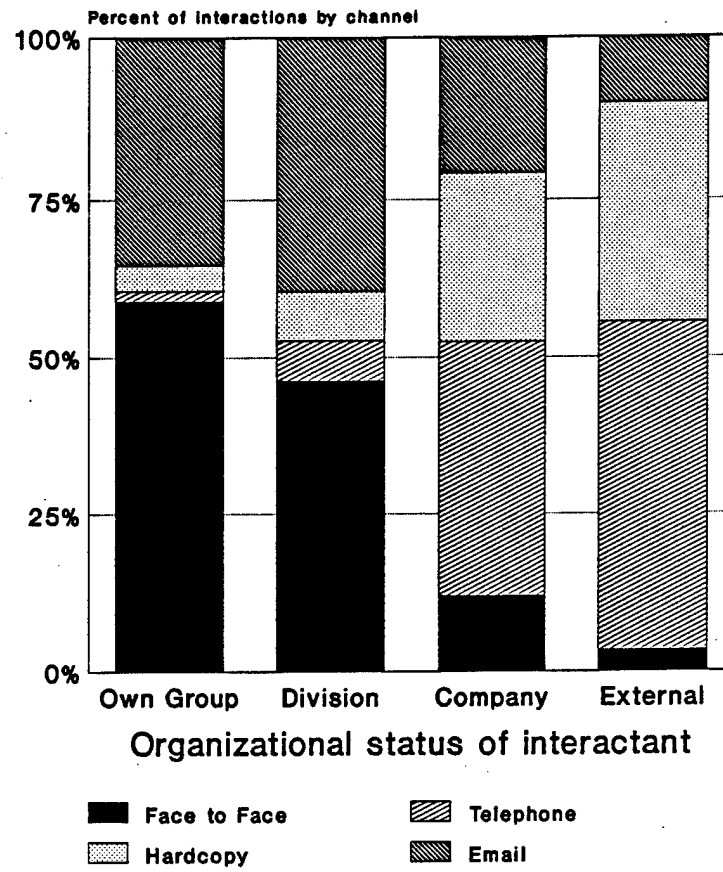
(N=2671)

Figure 5.24   Organizational Communication by Interactant's Status

company tended to rely less on email is all that's needed to generate the observed tradeoff.

Although this line of explanation accounts for some part of the observed patterns of organizational communication, there are other aspects of the data which must be accounted for in different terms. Of particular interest is the suggestion in these data of how use of the newest medium (email) has been adopted. Email has been around long enough for its use to have stabilized in this setting. Rather than being used primarily for distant communication, this "leading edge" technology has found its main niche in organizationally proximal communication. Perhaps this reflects a "bottom-up" implementation process from an organizational point of view or perhaps, a distinctive functional niche within the overall communicative economy of this setting (Reder & Schwab, 1989).

We shall return to discuss the theoretical implications of these findings in Chapter 8 after the corresponding data from Site 2 are considered in Chapter 7.

5.7 Interactional Chains and Channel Switching

Cooperative work is often accomplished in part through a series of interactions among collaborating participants. The periods of solitary work which individual participants devote to accomplishing their parts of a cooperative task are intertwined with meetings, the exchange of written information and other interactions with task participants. Communication plays a crucial role in the collective accomplishment of these cooperative activities. Communication is a means through which individuals structure, manage and coordinate the individual activities comprising the collective endeavor. Communication is also part and parcel of the interactive process through which substantive collaboration occurs in group action.

To highlight the role of communication in the observed activities of the studied workgroups, the concept of *communicative chains* was developed. A communicative chain is operationally defined as a sequence of distinct interactions between the same individuals on a given task. In our observational data, such chains are identified as a series of communicative events (within the same day) between the shadowee and another given individual (or set of individuals) pertaining to a particular task. Many such sequences include events over multiple days, of course; our analyses, however, are limited to those parts of such chains which occurred during a given day of observation.

Figure 5.25 displays the occurrence of such communicative chains in the observation data. The frequency of the chains is plotted as a function of the chain length. Such chains are fairly frequent overall, considering the fact that we are here examining only a small (within-day) segment of the totality of ongoing chains. Not surprisingly, as the length of the chains increase, their frequency diminishes (within a single-day frame of observation). If we next look at the channels used in the constituent communicative events ("links") of these chains, and calculate the number of chains which involve a *channel switch* (e.g., from telephone to face-to-face) from one link to the next, the results can be plotted as shown in Figure 5.26. When the chain length is only two communicative events, nearly 30% of the chains involve a channel switch. As chains progressively lengthen, the percentage having a channel switch steadily increases as well, rising to 80% by length five.
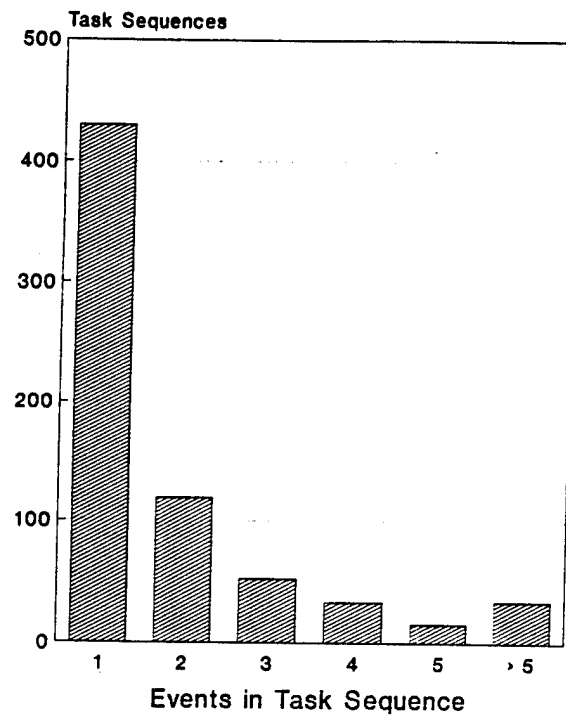
Figure 5.25   Communicative Chains
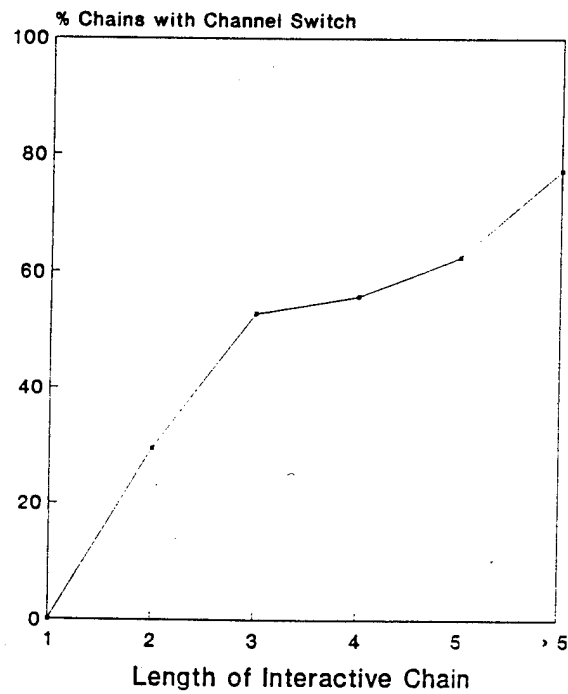
Figure 5.26   Channel Switching

Overall, 60.2% of all communicative chains involve a channel switch. Both of the studied workgroups display curves similar in shape to that shown in Figure 5.26. The overall percentages of communicative chains that involve a channel switch for the Component and Integration groups are 57.0% and 63.0%, respectively.

These results indicate that not only are communicative chains common threads underlying the accomplishment of cooperative tasks, they involve frequent channel switches among collaborating individuals as they work together over time. Using technology--rooted in the use of a single channel (as are most current "groupware" or group-support technologies)--to support the group accomplishment of such tasks would not fit well with the natural activity and communication patterns of workgroups such as those studied here. The implications of this important result for the goals and design of group-friendly interfaces will be considered in more detail in Chapters 10 and 11, after the corresponding Site 2 results have been considered..

5.8 Multitasking

Section 5.2 indicated that individuals are engaged in a large number of tasks in a given day, and interact with a large number of individuals as well. The results of the preceding section (5.7) indicate that many of these activities and interactions are structured into communicative chains, which likely crisscross each other in the temporal sequence of an individual's busy day. Mintzberg (1973) has characterized the activities of the executives he observed as having a high degree of "brevity, variety and fragmentation. This description, of course, is exactly what would be observed as an individual participates in multiple, temporally overlapping activities. To participate in multiple tasks involving other individuals, a worker must frequently jump back and forth among tasks, creating a situation with which many office workers are all too familiar: having too many jobs to do at once, too many interruptions, not enough hours in the day, resulting in tasks just "getting stacked up." These observations suggest that a *multitasking metaphor* as Sproully (1984) suggested, may provide a useful way to conceptualize and analyze the activities of individuals and workgroups.

5.8.1 Measuring task stacks. To operationalize multitasking in our shadowing data, we defined a simple way of measuring, on an ongoing basis, the size of the activity "stack" of an individual being shadowed. The operational definition used, termed here *Method A*, identifies a given task as being on an individual's "stack" whenever the individual (1) is not working on it at the moment; (2) has worked on it previously in the day; and (3) works on it again later the same day. Method A has the advantage of being based entirely on observed activities, but the drawback of measuring only that fraction of an individual's task stack visible within the frame of a single day; excluded from the Method A measure are tasks that start one day and are returned to a different day, for example. Nevertheless, the measure seems to capture evaluative differences between individuals in terms of how busy.....A second operational definition will be considered in Chapter 9 below.

The Method A stack size measure was computed at the beginning of each episode in the shadowing data. Both maximum ("peak") and running averages of the measure were then computed for each shadowing session. These per session measures were averaged to yield both per individual and per workgroup measurements. The workgroup level data are presented in section 5.8.2, and the individual level data in section 5.8.3.

5.8.2 Workgroup level averages. Figure 5.27 displays workgroup level averages of the size of individuals' task stacks using Method A. The tops of the hatched portions of the bars in this figure represent the mean peak values of the stack size for a day, whereas the tops of the solid portions represent the mean running average stack size over a day.

There are no substantial overall differences between the Component and Integration groups evident in the figure Looking at both the running averages and peak values, members of the groups have on the average about twice as many tasks in their stacks as when they are at a peak as they "typically" do during the course of a day.

5.8.3 Individual level averages. Despite the lack of overall differences between the workgroups, there are widespread individual differences in stack size. The data for individual participants are displayed in Figure 5.28. Individuals displayed in the figure are ordered by their workgroups. The lack of substantial workgroup differences seen in the previous section are put into perspective here by profound individual differences. The range of individual differences seen (each of which are average values from four complete days of shadowing) in the figure represent a profound level of variation in terms of either the running average or scale value data. The most "stacked up" individual typically has about twice as many tasks on his or her stack as does the least "stacked up" person.

It is important to point out that the linear scale of measurement displayed in the figure does not do full justice to the likely impact of these differences. Just as juggling four balls is substantially more than twice as difficult as juggling two balls, so may "juggling" (i.e., multitasking among) four tasks be more than twice as difficult as "juggling" two[9].

Individuals in the figure within the groups are arranged spatially in the same order they are in Figure 5.11. Individuals in managerial roles within the teams are on the left. There is the suggestion here, as there was in Figure 11, that the data are more sensitive to individuals' functional roles within groups than to the characteristics of the overall group.

5.8.4 Covariation of stack size with number of tasks per day. To examine these individual data further, Figure 5.29 cross-plots individuals average number of tasks per day and running average of task stack depth. Each point plotted is the average mean stack size over the individual's four days of being shadowed. Members of the two workgroups are plotted with distinct symbols.

Several observations can be made about the figure. First, the general shape of the scattergram reflects an anticipated positive correlation between the number of tasks per day and the average stack size for the day. Second, even though there is a positive correlation between the measures, they do measure different things. Looking at an imaginary vertical line drawn across Figure 5.29 at Stack Size = 3, for example, we see a wide range of average Tasks/Day associated with a given stack size. The ways in which individuals sequence and manage a given set of tasks (i.e., their multitasking behavior) influences the size of their task stack. Third, as suggested at the end of section 5.3.3, individuals' roles within a group condition their

---

[9] A quadratic scale might be more appropriate to characterize the relative burdens imposed by task stacks of various sizes. After further data and theory become available about the impact of multitasking on task performance, a series of measurement issues can be better investigated.
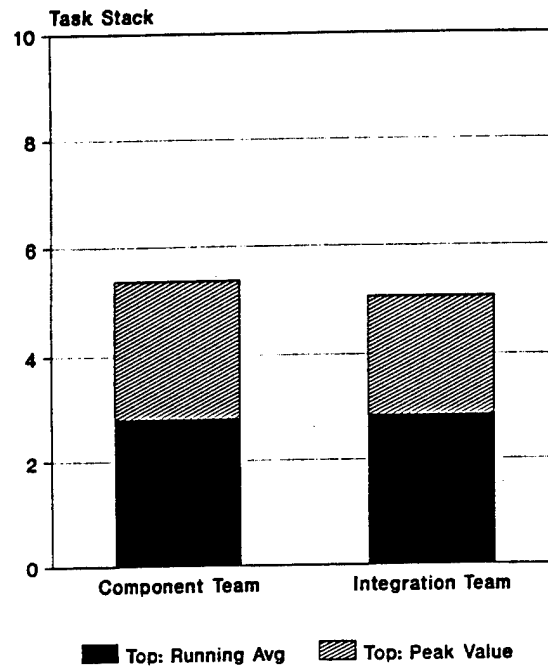
Figure 5.27   Workgroup Levels of Multitasking (Method A)

Figure 5.28   Individual Task Stacks (Method A)

Tasks per Day

*   Component Team   +   Integration Team
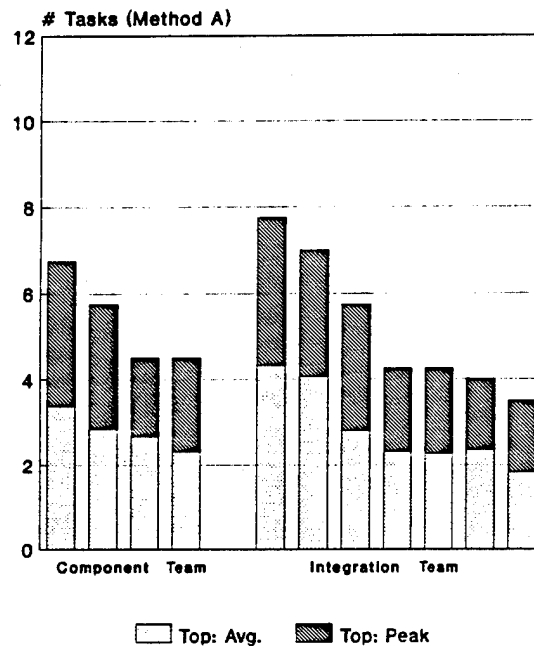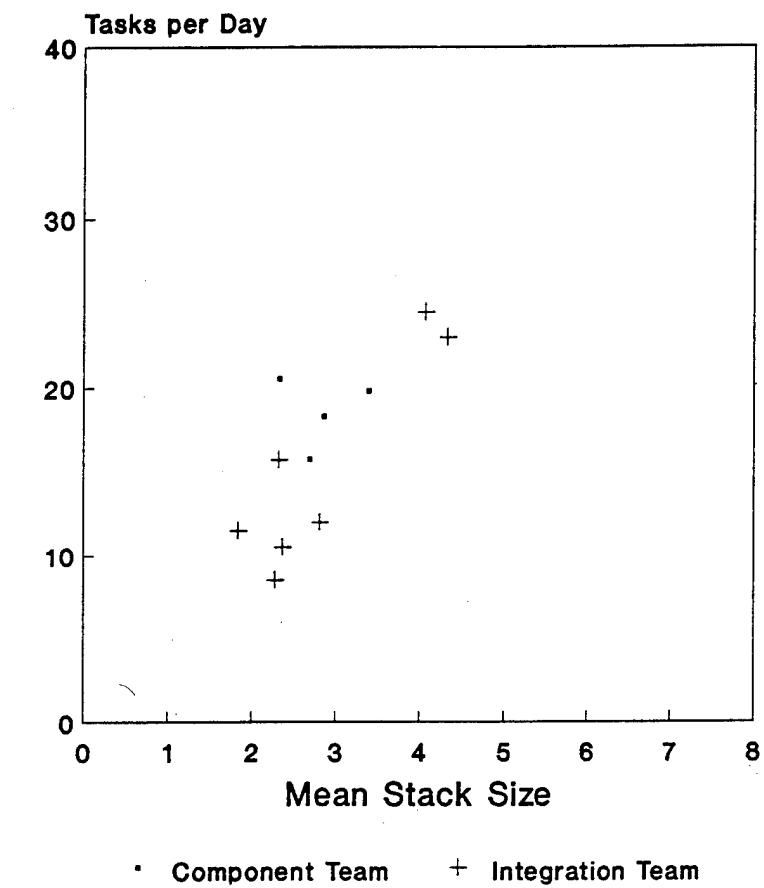
Running average (Method A)

Figure 5.29   Tasks/Day x Stack Size (Method A)

communication and task management strategies and hence the values of such measures.

5.8.5 Impact of multitasking.

Although the quantitative impact of such multitasking on task performance cannot be directly assessed from these analyses, our qualitative data leaves little doubt about the generally negative impact of excessive multitasking. There are constant conversations and reminders in this environment -- and in many business environments -- about the importance of task prioritization and efficient "time management." As in many office settings, there is a great deal of concern and conversation directed towards issues of time management and task prioritization.

One of the effects of excessive multitasking, of course, is to reduce the size of the time slices available for conducting a task. Individuals with substantially larger average stack sizes tend to exhibit markedly smaller durations for solitary work as displayed above in Figure 5.11 in section 5.3.3. Those mean episode durations are the average "time slices" available for accomplishing tasks.

5.9 Self-Management Activities

Given this picture of the temporal organization of activity among workgroup members -- of multiple, ongoing and highly intertwined (i.e., "stacked up") tasks -- individuals clearly must expend considerable effort towards managing their own time and task load. As noted in Chapter 3, such activities as going through one's inbox, sorting through a stack of phone messages, reviewing one's calendar, filing a series of documents were classified as being non-task-specific. Such self-management and self-organization activities are termed here "non-specific" tasks. Their distributions across the two workgroups are shown in Figures 5.30 (percentage of episodes of non-specific activity), 5.31 (percentage of time in episodes of non-specific activity) and 5.32 (mean duration of episodes of non-specific activity)[10].

As might be expected from their somewhat higher numbers of tasks per day, members of the Component workgroup spend a higher percentage of their time on these non-specific tasks than do members of the Integration workgroup (Figure 5.31). These self-management activities consume about 15% of the time of the Component Team members.

---

[10] In these data, a small number of compound episodes have been excluded; excluded were compound episodes in which both specific and non-specific events took place. As noted in the footnotes to the figures, these exclusions comprised only 0.8% of the observed episodes and 0.9% of the observed time.
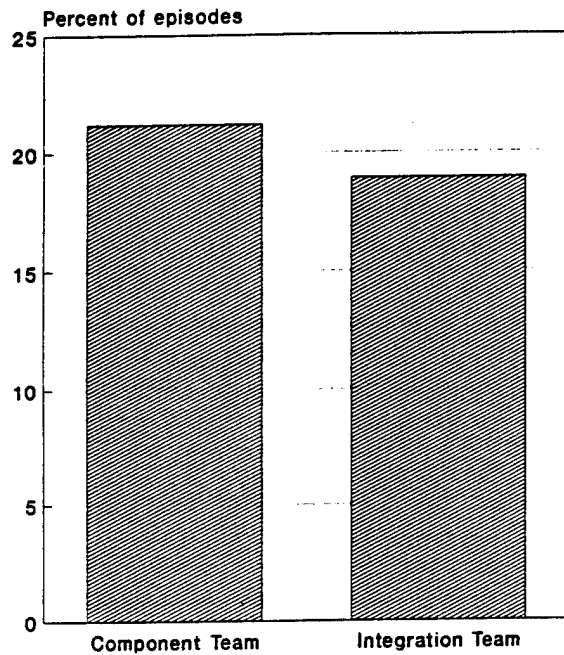
Percent of episodes

(N=3295; excludes episodes having both
specific and non-specific activities:
excludes 0.8% episodes, 0.9% total time)

Figure 5.30   Non-Specific Activity: Episode Distribution
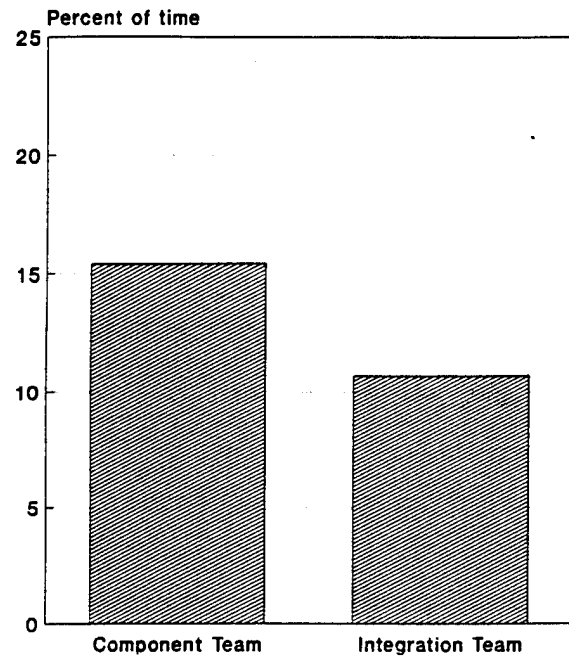
Percent of time

(N=3295; excludes episodes having both
specific and non-specific activities:
excludes 0.8% episodes, 0.9% total time)

Figure 5.31   Non-Specific Activity: Time Distribution

Minutes/Episode
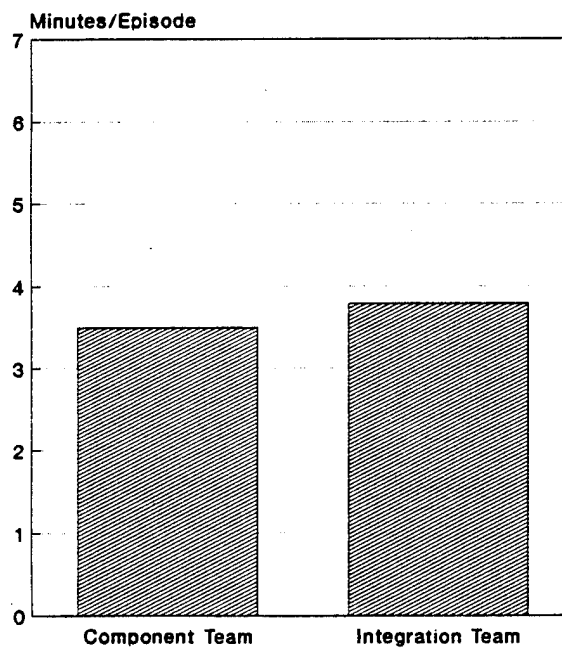
(N=623) excludes episodes having both
specific and non-specific activities:
excludes 0.8% episodes, 0.9% total time)

Figure 5.32   Non-Specific Activity: Episode Duration

5.10 Summary

In this chapter the results of the shadowing study in Site 1 have been presented. Particular attention has been given to the comparisons of the Component and Integration workgroups. By and large, as detailed in the preceding sections, the two workgroups exhibit some of the similar quantitative characteristics in work patterns and use of communication channels. In some cases, of course, workgroup differences were observed. In other cases, workgroup differences were not found, but profound individual differences were observed. These individual differences , especially, those pertaining to the temporal patterning of work activities and the dynamic management of an individual's multiple tasks, appear to reflect the functional role of the individual within the group rather than the characteristics of the group per se. There will be more to say about these relationships after additional results from Site 2 are considered in the following chapters.

6.0 Site 2: QUALITATIVE RESULTS

This chapter represents some of the key findings of the qualitative study of Parallax Corporations's Convex Systems Division. Like Chapter 4, the material presented here is focused as workstyle, genres of communication, and channel choice and channel switching behaviors. This chapter is intended to compliment the quantitative findings which appear in the next chapter.

6.1 Workstyle in CSD

The three groups targeted for study in CSD differ in several key respects (summarized in Figure 6.1), and it is useful at this point to consider those differences in some detail. The Senior Management Team is stratified with peer-like roles for some (Vice President of Sales and Vice President of Marketing) and asymmetrical for others (General Manager and Director of Human Resources). Group membership is relatively stable and the group has a clear sense of their roles as a team. All but one of these individuals is located in the Division headquarters on one side of a single floor[1]. All of the members of this group travel frequently and, as a result, they are unavailable for face-to-face interaction with other members of the group a significant portion of time. Strategic planning and Division operations are key activities for members of this group and, in contrast to the other studied workgroups, the emphasis of this group is on decision management. This is an important contrast in that this group is responsible for long-term planning and strategy for the Division, but also for interpreting and implementing corporate level vision and goals. The focus of the work is thus external to a greater degree (outside the Division) than for either of the other two groups.

The members of the Sales Development group are dispersed throughout a multi-state region, and travel for these workers is frequent. Compared to the other two groups, the Sales Development Group's membership is relatively unstable and several personnel changes occurred during the course of the study. The Group is organized into five sub-groups focusing on product/service areas, composed of managers from different regions who see themselves as peers. While some of these members are specialists and devote all of their time to a specific product/service area, others split their time among two or three areas. Though there are team leaders, leadership is based on technical knowledge and the role of leader involves recognition of that knowledge. The leader is thus a resource and not a role significantly differentiated from those of other team members in terms of status.

Within the Sales Development group the emphasis is on facilitating and accelerating the sales process, and workers focus their energies to assist with finding and cultivating sales. Members of this group do not, however, "make the sale" since this is left to the appropriate account representatives. In this sense, the group can be described as "process oriented" in that it is structured to support the process of a sale and is not responsible for the sale itself. In fact, the role of the Sales Development Group is sometimes described as somewhere between Sales and Marketing.

---

[1] The one exception is President of a company acquired by CSD, Optikos Systems, Incorporated. Though he is considered a member of the Senior Management Team for CSD, his position on the team is essentially nominal.

workgroup	nature of work/modes of work	location	travel	physical space	available channels	history/context	homogeneity/ composition	span of responsibility
Senior Management	product and process oriented; decision management; strategic planning; Division operations; long term goals; work with all sections of Division	proximate core group; often dispersed by travel	high travel	private office with doors; executive floor	email; voice mail; secretarial support; cellular phones in cars for key members; human mediation of communication high; machine mediation low	established group; relatively stable	heads of sections	responsible to corporate officers
Sales Development	Process-oriented; short to medium goals; region/account vision; work with sales and marketing	core group dispersed	medium travel	offices and cubicles; peripheral to regional sales staff	some lack email; no voice mail; low secretarial support; machine mediation high; human mediation low	new group; shifting membership	managers from different regions with different backgrounds	responsible to VP Sales; responsible to regional sales staff
Marketing	product-oriented; medium term planning; product vision; work primarily with marketing	core group co-located	low travel	cubicles; among other marketing groups	no voice mail; one person no email; low secretarial support; machine mediation high; human mediation low	new group; stable	managers from different backgrounds from same region	responsible to Director and Product Managers

Figure 6.1   Contrasts in Workgroups: Site 2

The group has a twin focus. Members are individually assigned to specific products and services, but their responsibilities are regional and/or account specific. The implications of this are significant in terms of the structure of their work. As members of product/service teams they work with other team members in developing strategies, obtaining technical assistance and sharing experience. At the same time, their regional and account specific concerns require close collaboration with sales staff within their home region. In practice, a Sales Development Group member spends more time working independently or communicating with local sales staff than with other Sales Development staff.

The nature of the work completed by the Marketing Group requires very infrequent travel. The group is stratified with two product managers reporting to one mid-level manager. Though the group supervisor's role involves overseeing the activities of the group, in fact the group functions on a day-to-day level very much as a group of peers. Though each of the three workers has individual market areas of responsibility, their work areas are in close proximity and they work together to a greater degree than do the members of the other two groups.

As might be expected, this group is product oriented. Where the Sales Development Group was focused on the development of the sales process, this group is most concerned with tasks which culminate in the deployment of products. Thus the context of work is different for the two groups.

To illustrate the nature of work among the groups studied in CSD, it is useful to look at the pattern of work as a worker addresses a specific task. In the following example, Joyce Washington from the Marketing group was working to resolve a billing issue related to a new product. The Skyline project raised a complex problem which had no real precedence and so required the collaboration and coordination of many different workers throughout the company. The sections which follow illustrate the thread of activity from the point of view of Joyce. As will be seen, her work day involved several other activities and tasks but the Skyline billing issue punctuated the day.[2]

> 8:10-8:52
> Joyce arrives at work and is working on several distinct tasks.
>
> 8:52-8:57
> Joyce receives a call from Karl Kesey, a company employee who has been contacted to assist in resolving the Skyline billing issues. Karl needs background information and Joyce refers him to Pete Carson, a Division employee assisting with the issue.
>
> 8:57-8:59
> Joyce immediately writes a note to herself documenting the call from Karl Kesey.
>
> 8:59-9:04
> Joyce is interrupted by a co-worker and has a conversation regarding another task.

---

[2] This representation of a portion of Joyce Washington's workday is derived from Shadow observation records and fieldnotes.

9:04-9:52
Joyce attends a meeting on another subject but before the meeting begins Joyce updates her supervisor, Nora Gray, on the status of the billing issue. Their conversation is brief and no activity is planned.

9:52-9:58
After a brief personal chat with a co-worker, Joyce returns to her desk and resumes working on a task unrelated to the billing issue.

9:58-9:59
Joyce phones Nora (approximately 50 feet away but out of sight) and asks if she can come to Nora's cubicle to talk about billing. Nora says "yes," and Joyce hangs up the phone, collects her notes and walks directly to Nora's cubicle.

9:59-10:12
Joyce arrives at Nora's desk and they discuss the billing issues. They work together to identify the best plan to approach the issue. Nora "proposes" that Joyce contact Nancy Crawford, a non-CSD employee, and Pete Carson as the next steps in the process. Nora then asks Joyce to let Ray Forge know there will be no lunch time staff meeting today (along with Nora and Joyce, Ray is in the CSD Marketing Team targeted for study).

10:12-10:16
Joyce returns to her desk and reads a personal "broadcast" message displayed on her computer screen. She then reads material related to another task.

10:16-10:17
Joyce attempts to call another CSD employee, Helen Marshall. A secretary answers the phone and reports that Helen is away from her desk. Joyce leaves a message asking Helen to call.

10:17-10:23
Joyce reviews her notes on the billing issue.

10:23-10:28
Walking across the hall to Ray Forge's cubicle , Joyce passes on the message from Nora that there will be no staff meeting today. They discuss a second, unrelated task.

10:28-10:29
Joyce returns to her desk, reviews notes and makes additional handwritten notes.

10:30-10:31
Joyce uses the broadcast capability of the TOPS local area network to send Pete Carson (located one floor above Joyce) a message asking who might be available outside CSD to assist with the billing issues.

10:31-10:38
Joyce resumes reviewing written notes.

10:38-10:38
Joyce receives Pete Carson's broadcast reply to her earlier question. Pete provides the name of a person in Houston but notes she will not be available for three months.

10:38-10:44
Joyce transcribes the substance of Pete's message to a sheet of paper and adds it to her Skyline Billing file.

10:44-10:46
Joyce phones Pete Carson but a secretary answers and Joyce leaves a message asking Pete to call about Skyline.

10:46-10:49
Joyce phones Nora to fill her in on Pete's message.

10:49-11:06
Helen Marshall arrives as Joyce completes her discussion with Nora. Helen remarks that she received the phone message and they begin to discuss the billing problem and collaborate to identity the most effective ways to resolve the problem. Helen volunteers to coordinate with three other Parallax staff, Karl Kesey, Nancy Crawford and Karen Easton. Helen suggests Joyce call Dan Peterson (Helen's supervisor) to find out who is assigned to do manual billing. They then chat briefly about personal news.

11:06-11:11
Joyce calls Nancy Crawford but Nancy is unavailable and Joyce ends up leaving a message.

11:11-11:12
Joyce writes notes to herself for the billing issues file.

11:12-11:13
Joyce calls Dan Peterson. He is not there, so she leaves a message asking who he has assigned to do manual billing.

11:13-11:15
Joyce writes more notes to herself for the billing issues file.

11:15-11:15
Joyce attempts a personal phone call but there is no answer.

11:15-11:22
Joyce writes notes on billing issues.

11:22-11:23
Joyce walks to receptionist's desk to check for phone messages. There is one message from Helen Marshall but the time indicates it preceded Helen's 10:49 visit to Joyce.

11:23-11:25
Joyce resumes working on notes regarding billing issues.

11:25-11:27
Joyce phones Karl Kesey but he is out. She leaves a message for him to call after lunch.

11:27-1:05 lunch

1:05-1:06
Returning from lunch, Joyce calls Pete Carson but he is away from his desk. She leaves a message for him to call.

1:05-2:10
Joyce is involved in 6 separate tasks, none of which are related to the Skyline billing issue.

2:10-2:15
Nora arrives at Joyce's desk and interrupts another task. She asks for an update on the billing issues. Joyce gives status, Nora leaves and Joyce resumes working on the other tasks.

2:15-2:56
Joyce continues working on a series of unrelated tasks.

2:56-2:56
Nora appears and asks Joyce for help with the email system. They walk to Nora's desk and Joyce provides assistance.

3:00-3:01
Walking back from Nora's desk, Joyce collects a phone message from Pete Carson. The message indicates he returned her call and asks she call him back.

3:01-3:37
Joyce calls Pete Carson and suggests they add Nora to the call. One minute after the call began, Nora, Pete and Joyce are on the line together. During the telephone conference call, problems are identified, strategies agreed on and consensus reached. Joyce writes notes as the meeting progresses.

3:37-3:45
While Joyce continues to write notes on meeting, Nora appears and asks for a copy of Joyce's notes. Joyce agrees and says she will drop them off later.

3:45-3:45
Joyce receives a call from another worker pertaining to another task.

3:45-3:46
Joyce receives a broadcast message from the receptionist (30 feet away but out of sight). The message indicates Dan Peterson's secretary called and said Peterson is out of the office until the next week.

3:46-3:56
Joyce resumes writing notes based on the conference call.

3:56-3:58
Joyce walks to photocopier and copies notes for Nora.

3:58-4:00
Joyce walks to Nora's cubicle and delivers the copy of her notes.

4:00-4:15
Resumes the task interrupted by Nora at 2:56.

4:15-4:20

Nora brings Joyce a copy of a document which will provide some help to Joyce as she works through the billing issue. Nora tells Joyce to study the document and speak to her if she has any further questions. (Joyce had no further activity on the Skyline billing issue for the rest of the day).

Though this example depicts a general pattern of work activity for members of the marketing group, it also reflects many of the typical patterns of work within CSD: Tasks are often accomplished in spite of frequent interruptions, several tasks must be attended to at once, and workers must make decisions and choices regarding who to collaborate with and which communication channels to employ to suggest that collaboration.

6.2 Genres of Communication and Communicative Style in CSD[3]

An "objective setting" session is an example of a genre of communication unique to CSD workers involved with sales. The Sales Development Team is thus the only targeted group all of whose members are involved in objective setting sessions.[4] During these sessions a worker and his or her supervisor meet to set a quota for personal sales for the coming year. These sessions are always scheduled, conducted face-to-face and private. There is no fixed structure for these meetings and though formal, the tone is set by the interactive style of the supervisor and the worker.

"Staff meetings" are a ubiquitous genre of communication for most organizations and CSD is no exception. Each of the workgroups holds staff meetings but they differ significantly among the groups. For the Senior Management Team, staff meetings are held weekly provided there is what they term a "quorum" at Headquarters; the decision whether or not to hold the meeting is made Friday afternoon. If an insufficient number of group members would be present, the meeting may be postponed. Meetings are typically held on Monday mornings at 8:00am and scheduled for two hours though meetings run over and under time depending on the topics under discussion. Once a month the group meets for a full day and addresses specific topics in more detail. The meeting is sometimes structured by an agenda and there is always an opportunity for members of the group to raise and discuss issues. The General Manager chairs the meeting and the tone is typically relaxed and brisk. Though one team member participates by teleconference since his home office is several hundred miles and two time zones away, it is unusual for others dispersed by travel to "call in" to the meeting. The meetings often include formal presentations by CSD workers but these presentations are typically limited in length and etiquette appears to be that presenters exit the meeting when they have completed their segment.

In contrast, staff meetings among the Sales Development Group are very different. Because of spatial dispersion it is not practical to bring the individuals together to meet on a frequent basis. Consequently their staff meetings are held by way of a telephone conference call approximately every two weeks. These meetings are chaired by the Sales Development manager and typically last under two hours. An agenda distributed in advance by fax or mail usually precedes the meeting.

---

[3] Though there are numerous distinct genres in CSD, only a few examples will be presented here to illustrate some of the key contrasts among the targeted groups.

[4] The Marketing group was not directly involved with sales and so was not involved with these meetings. On the Senior Management Team, only the Vice President of Sales was involved with such sessions.

As an alternative to the conference call staff meeting, group members met face-to-face approximately every six weeks. Rather than being held in one city, the meetings were rotated around the dispersed sites. The meetings varied in length but averaged one full day in duration. The meeting was preceded by a "team building" evening the night before in which the group went out to dinner and took the opportunity to socialize. Because the group was together so infrequently, all of the members saw this opportunity as critical to their sense of group identity.

The Marketing group is different than the other target groups. This group made an effort to meet as a group once a week for lunch out of the office. Though there were occasional impromptu gatherings which involved the operation of the group, the "staff meeting" was the weekly lunch. The structure of these meetings was very informal and there was no fixed agenda. Meetings were not held if one of the team was unavailable. In addition, all three members of the group attended a weekly staff meeting for the larger Marketing section of which they were a part (Figure 2.2). This meeting, in contrast, was highly structured and regulated.

A third and final example is the "product team meeting." This genre was the communicative means for bringing together members of a product team in order to check status, plan development, negotiate roles, clarify issues, delegate tasks, and build consensus. This genre was observed among members of the Sales Development and Marketing groups, but not among the Senior Management Team. The Sales Development product team meetings tended to be informal, loosely structured and not functionally specialized to a single channel (i.e., the communication was accomplished through face-to-face, telephone and to a lesser degree through other channels). Meetings were organized on an as needed basis. Participants tended to include other members of the group or a limited number of other CSD staff, and meetings were typically held in the office of a participating Sales Development member.

Among the Marketing Group, on the other hand, the product team meetings tended to be extremely formal and highly structured. The meetings brought together workers from other groups and sometimes other divisions of the company. The tone of these meetings tended to be almost adversarial at times and politically charged. Though everyone professed a desire to do what's best for the company, real tensions arose from differing perceptions of specifically what should be done, when, and by whom. Such meetings thus had to be carefully orchestrated to obtain the commitments "buy-in" from the necessary parties. Consequently, agendas were carefully produced and followed and "action items" were delegated to attendees. Convened in a conference room, the meetings were functionally specialized to face-to-face interactions; participants rarely used teleconferencing in these meetings.

6.3 Channel Choice and Channel Switching[5]

As in NPD, channel choice is a significant variable in the communicative arena of the CSD workplace. In the following piece of email, Shirley Hymes, secretary to Rich Thomas, Vice President and General Manager of Convex Systems Division, sends a "reminder" to Ann Gold, Thomas' Executive Assistant and Manager of

---

[5]   A general discussion of channel choice and channel switching is provided in section 4.4 of this report.

Division Strategy.[6] The message refers to a printed schedule of all-day meetings of the CSD Senior Management Group, referred to in this memo as "Staff":

MSG:FROM:SHYMES --NODEXXX   TO:NODEXXX 05/15/89 15:53:02
From: SHIRLEY HYMES
      8T30 PAXON BLDG
Subject: CSD Staff Meeting hand-out material

Ann, just a reminder--when you hand-out material (particularly meeting date material) in CSD Staff meetings and I am not present in the meeting, could you please make sure I get a copy of that material. A revised Staff Full-Day meeting scheduled was handed out in one of these all-day meetings recently, and I apparently was not there and did not receive a copy. Freda and I were discussing the meeting schedules and I realized I didn't have the latest. She then gave me a copy. It's important that I have this information accurate for obvious reasons.

Thanks,

SHIRLEY HYMES
(861-569-4389)

Though it would have been possible to interview Shirley and attempt to solicit her motives for this particular choice of channel, that is not the goal of this exercise. This message is of interest in that it provides an opportunity to explore some of the dimensions and implications of channel choice in CSD. If we examine the message carefully, a series of relevant considerations highlight some of the factors observed in channel choice:

o   Strategy. In CSD, as in other work settings, the selection of channels may be influenced by considerations of the political context of the workplace. Both Shirley and Ann work for Rich Thomas and Shirley may have felt that the significance of her role was overlooked or ignored by Ann. From Shirley's point of view, this had significant implications for her ability to do her job. Given the asymmetrical nature of their roles, a direct, face-to-face confrontation between Shirley and Ann may have been awkward and uncomfortable, but an email message would provide a less confrontational means to raise the issue.

In CSD, as in other work environments, channel choices are always embedded in complex understandings of the communicative economy of the workplace. Shirley was fully aware that Ann was a consistent and predictable user of the electronic mail system in CSD, this is stark contrast to other the majority of workers. Thus, knowing who is "on the system" is an important piece of strategic knowledge which workers must include when making choices concerning appropriate

---

[6]   Shirley's desk is in a reception area outside Rich Thomas' office, less than 50 feet away from Gold's office. Freda, referred to in Shirley's message, is Ann Gold's secretary.

channels. This is true for ensuring a message is received or--conceivably--not[7].

o   <u>Workplace/workgroup Style</u>. In some settings, particular channels are more accessible, are of higher quality, are valued more highly by the group, etc. As a result, channel choices are shaped by factors often beyond the individual's control. In CSD, for example, electronic mail was available though difficult to use. Rich Thomas believed that electronic mail was a useful channel yet he did not insist that workers in the Division use it. Still, as Rich's secretary, Shirley may have felt compelled to use the channel because he did (if only to a limited degree).

o   <u>Control</u>. During synchronous communication such as telephone calls or face-to-face meetings, participants are involved in an often unpredictable exchange of information, and it may be difficult for a speaker to ensure he or she says exactly what he or she means. Where status differences are involved, the lower status worker may find him or herself in a position where the flow of information is controlled by the higher status worker. On the other hand, an electronic mail message, like a hardcopy document, is asynchronous. Shirley was able to take as much time as necessary to carefully craft a tactful and effective message. Again, where status differences are involved, an asynchronous message allows the lower status worker to retain some control--at least temporarily--over which questions are asked or answered[8].

Sending a message through an asynchronous channel such as electronic mail allows the sender to retain a greater degree of control over the duration, focus and content of the message. In this case, email may have been selected as the most appropriate channel in order to save time. Even though the close proximity of their offices often enabled Ann and Shirley to see one another several times a day, face-to-face interactions provided opportunities for--and sometimes required--the exchange of information on a number of distinct topics rather than one (this may either an advantage or a disadvantage, depending on the context)[9].

o   <u>Scheduling</u>. An email message provides a quick and efficient means for getting information from one person to another when they are not physically present in the same place at the same time. Given her heavy travel schedule as a member of the Senior Management Group, it is possible that Shirley chose electronic mail as a channel because it allowed her to "leave a message" Ann could access at her convenience when she returned.

---

[7]   One worker commented that the phrase "You didn't get it? I sent you email" was a standing joke in CSD, akin to the well worn excuse, "the check's in the mail". According to this worker, the system was inefficient and usage so sporadic that sending or claiming to have sent an email message was a useful strategy for "buying time".

[8]   Obviously, control is the critical variable when status differences are involved. A carefully crafted email message is of little value if the superior decides to switch channels and demand a face-to-face meeting!

[9]   Norms of politeness may encourage a lengthier interaction than is necessary for the simple passing of informaiton as Shirley intended.

o   <u>Going "on Record"</u>. Like a written memorandum, an electronic memo creates a record of the interaction. In this case, Shirley's choice of an electronic medium might reflect a conscious decision to make her request a matter of record. Still, this choice would not formalize the interaction to the same degree as would a hardcopy document. The choice of an electronic rather than a hardcopy medium for the record places the message somewhere in between the informality of a spoken request and the formality of a written (paper) memo.

o   <u>Personal Preference</u>. Many workers develop communication habits which reflect personal preferences and styles. Ironically, Shirley's previous position was one in which an efficient and simple electronic mail system was available. Thus, while she had been an accomplished email user with a preference for the channel, in her current position she tended to use channels other than electronic mail. Her choice in this example may reflect a shift from a preferred channel.

The relative impact of these factors on this particular choice situation is not important. What is most significant is that given a range of possible channels, individuals make choices which influence and structure the course of interaction.

Another important aspect of channel choice is channel switching. As our qualitative data show, when a series of communications between two individuals extends over time, channel switching frequently occurs (quantitative aspects of this phenomenon are addressed in chapters five and seven). In the example which follows, Barbara Paris, Executive Assistant to Jenny Heath, CSD's Vice President Sales, asks Kelly Lords to participate in an upcoming teleconference. Barbara had tried unsuccessfully to reach Kelly over the telephone on several occasions, resulting in a long game of "telephone tag". Eventually she decided to change strategies and she switched channels (to electronic mail). Barbara's attempts to reach Kelly by email, however, were also frustrated, this time by a misspelled addressee name. Barbara guessed at several different spellings but the system did not recognize any of the suggested names and she was unable to send the message. An experienced email user, Barbara then accessed the system user directory to double check the addressee name and she quickly found the correct spelling.

Though there was an explicit invitation for Kelly to get in touch with Barbara (and
an implicit expectation that she should), the choice of channel was left up to Kelly.

A second example of channel switching involves a converse problem. In this case a
decision was made to use the telephone because the originator of the message failed
to reach the intended recipient through electronic mail. Contrary to the example
presented above, electronic mail was notoriously unreliable in CSD and thus little
used. Whereas it could have been an important tool for supporting the cooperative
efforts of distributed workers, it was undependable. On one occasion, Barb St.Clair,
a Parallax manager working as a member of the Sales Development Group, was
checking her email and discovered two messages from coworkers announcing their
vacation schedules. Realizing she had not notified her colleague, Sol King, of her
upcoming vacation plans and intended absence, Barb wrote an email message and
addressed the message to Sol, another member of the Sales Development team.
Though Sol works closely with Barb, their offices are 800 miles apart.

The email system refused to send her message, responding to her send command
with the message, "addressee unknown." Typically, this message indicates that the
sender has misspelled the name of the intended recipient. Barb checked the name
and tried to resend the message. In frustration she reached for the phone and
dialed Sol's office. She asked Sol if he was on the system and he replied that he was.
As a relatively new user, Barb was not confident that she was following the correct
procedures, so with Sol on the telephone line they retraced her steps only to find
that she was doing everything right. Finally, Barb gave up in frustration and said,
"I'll tell you what the email message was going to say." She then explained her
vacation plans to Sol over the telephone.

6.3.1 Probes of Channel Choice. In an attempt to augment the understanding of channel choice behaviors, a decision was made to attempt some explicit probes of subjects' channel choices in the second field site. Increasing the level of the observer's interaction with the subjects during these shadowing sessions, however, proved problematic. First, from the inception of the project, we developed and employed data collection methods which were minimally intrusive, and the success of the study--evidenced in the first field site--was clearly dependent on maintaining the highest degree of normalcy possible for the workers. Indeed, permission to conduct the research involved an undertaking on our part to minimize disruptions of ongoing work activities. Second, while a rigorous sampling of subjects' perceptions of their channel choice behavior might at first appear methodologically sound experiments with the techniques, raised questions of validity, e.g., that the subjects would become too self-conscious of their actions and that self-consciousness might affect their behaviors. In particular, subjects being shadowed might quickly learn to anticipate questions and perhaps alter their behaviors based on that anticipation.

In light of these considerations, the researchers decided to conduct only a limited number probes of channel choice behaviors. Channel choice probes were conducted during seven shadowing sessions involving five subjects. Following a communicative event, subjects were asked which alternative channel they would have used if the channel selected had for some reason not been available. Typically, choices were probed only two or three times during a session. Because the structure of work activity varied between individuals, it was not possible to "schedule" the probes; some workers had long periods with few communicative interactions. Consequently, channel choices were probed when the observer had opportunities to interrupt the subject with a minimum of disruption to their ongoing activities. Care was taken that the questions did not structure the options. For example, if a worker placed a telephone call to a workgroup member (Mary) in a remote location regarding her availability for an upcoming meeting, the following question was asked: "If for some reason it had not been possible to telephone Mary, how would you have obtained the information you needed?" By not suggesting a list of channel options it was hoped that the reply would be a spontaneous representation of what the subject viewed as the next best alternative.

The results of the channel choice probes are summarized in Figure 6.2. The first column, "Selected Channel", indicates the channel chosen by the subject. The second column, "Alternative Channel", shows the response given by the subject concerning the alternative channel the subject would have chosen if the first channel had for some reason been unavailable. The "Location of Recipient" column situates the target of the communication in question in terms of distance: remote (defined here as being too far away to be reached quickly by face-to-face communication) or local (close enough to the subject so that face-to-face communication is possible as a channel choice). The final column, "Session", refers to the shadowing session number.

For reasons discussed above, the results of the probes cannot be rigorously analyzed. In addition, the sample is extremely small. However, the results do suggest some patterns of heuristic interest. First, there appears to be some tendency for alternative channels to remain within the same temporal frame as the selected channel, i.e., subjects selecting a channel which allows synchronous communication tend not to choose asynchronous channels as alternatives to the selected channel. For example, informants indicated that telephone calls would replace all but one of the face-to-face interactions. The exception to this pattern emerges when the intended recipient is situated in a remote location. In four out of five of these cases,

92

Results of channel choice probes in Site 2

Selected Channel	Alternative Channel	Location of Recipient	Session
phone	fax	remote	33
phone	face-to-face	local	21
phone	fax	remote	35
phone	fax	remote	9
phone	US Mail	remote**	21
face-to-face	phone	local	9
face-to-face	phone	local	36
face-to-face	phone	local	22
face-to-face	phone	local	35
face-to-face	phone	local	35
face-to-face	phone	local	36
face-to-face	hand deliver	local	21
hand deliver	internal mail	local	34
hand deliver	fax	local*	34
voice mail	fax	remote	22

*recipient was normally in remote location but was present
in subject's location that day.

**recipient was not a Parallax employee.

Figure 6.2   Results of Channel Choice Probes in Site 2

an asynchronous channel was considered the most viable alternative. This, however, is not surprising given that the only other synchronous channel available in CSD--video conferencing--was expensive, difficult to arrange, and during the period of observation was never observed in use. When a communication occurs by way of an asynchronous channel, the alternative choice tends to be asynchronous as well. For example, subjects indicated that the next best channel for hand delivered hardcopy documents and the voice mail message choices would have been internal mail or fax.

Second, though electronic mail is used by several of the subjects, none cited it as a viable alternative to either synchronous or asynchronous communications. At the same time, fax , appeared to be the most common second choice of channel when the intended message recipient was remote. Though there are several interpretations which could be advanced, we feel the responses reflected recognition of the inadequacy of the email system in place in CSD, and not inherently greater capabilities of fax for communications.

7.0 RESULTS OF THE SHADOWING STUDY: SITE 2

This chapter presents the results of the shadowing study of the three workgroups described in previous chapters: the Senior Management, Sales Development and Marketing workgroups. The shadowing data, of course, can be aggregated, averaged and presented at several levels: at the *session* level (i.e., for a particular day on which a given individual was shadowed); at the *individual* level (i.e., data are aggregated and/or averaged over all sessions during which a given individual was shadowed); at the *workgroup* level (i.e., data are aggregated/averaged over all sessions during which workgroup members were shadowed); and at the *overall* level (i.e., data are aggregated/averaged over all shadowing sessions).

For most analyses, data are presented at both the *workgroup* and *overall* levels of aggregation. To maintain the anonymity of the individuals who participated in the shadowing, individual level data are presented only when they are essential to an analysis; in those few instances when individual level data are presented, individual identifiers are never presented.

7.1 Time and Activities at and Away from Desk

Individuals were shadowed both while they were at their desks and away from their desks. Overall, individuals were in the proximity of their desks[1] for 68.72% of the time they were shadowed (154.09 out of 224.22 hours[2]). Figure 7.1 displays the variation of the percentage of "desk-time" by workgroup[3].

Members of the Senior Team spend, on the average, only 58.6% of their time in the proximity of their desks, substantially less than members of the other teams. There is wide variation among individuals in their percentage of "desk time", depending primarily on the extent of their engagement in meetings in other offices or conference rooms. Overall, about 2/3 of time away from one's desk is spent in meetings, chiefly in other's offices (i.e., in the vicinity of others' desks) or in conference rooms. The three workgroups differed in their pattern of conference room utilization; members of the Senior Management Team used large and small conference rooms for about equal amounts of time, whereas members of the other teams met in small rather than large conference rooms for much more time.

7.2 Basic Activity Measures

Two descriptive measures of activity in a day are the number of distinct tasks[4] in which a person is engaged and the number of distinct individuals with whom a person interacts. These measures each tend to increase substantially on workdays perceived as "busy" and tend to decrease markedly on workdays perceived as being

---

[1] For the purposes of this analysis, an individual was classified as being "at desk" while observed in his or her office or cubicle (some individuals' desks were located in private offices, others' in cubicles).

[2] Fractions of hours are expressed throughout this report as decimal quantities rather than minutes and seconds, so that 3.50 hours represents 3 hours and thirty minutes rather than three hours and 50 minutes.

[3] Each time a figure is presented in the text, corresponding numerical quantities are tabled (with a number corresponding to the figure) in Appendix A, e.g., Table 7.1 in Appendix A lists the hours at desk for each of the workgroups, corresponding to Figure 7.1.

[4] See Chapter 2 for definition and recording of distinct tasks.

% of time
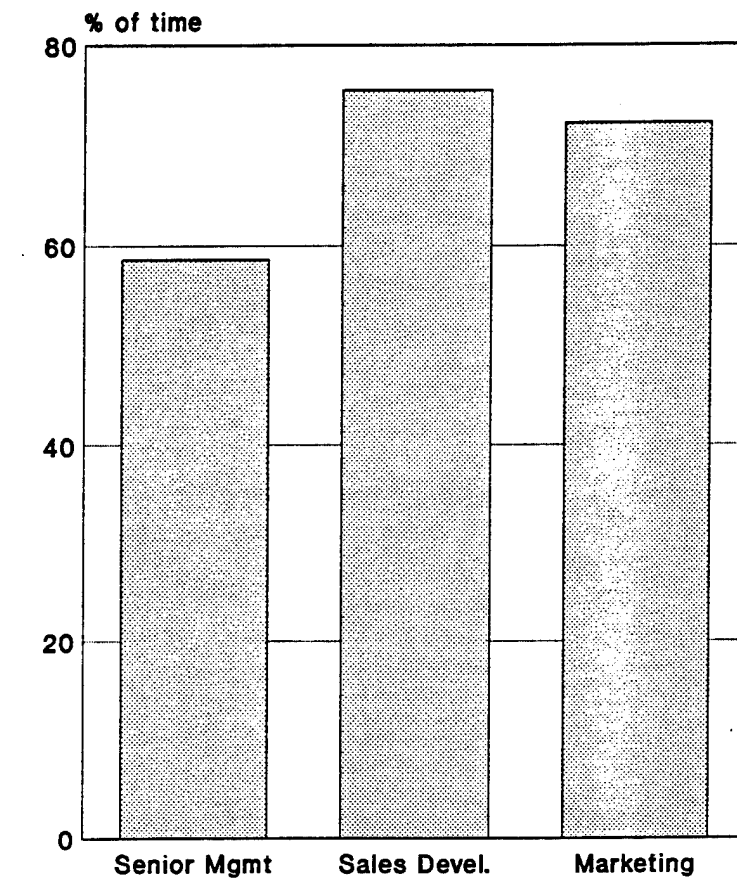
Note: For days in office

Figure 7.1   Time Spent in Proximity of Desk

relatively "quiet." Figures 7.2 and 7.3, respectively, display the averages of these measures on a per day basis for members of the three workgroups.

7.2.1 Tasks per day. In Figure 7.2, we see that members of the Senior Management Team are engaged in substantially more tasks per day than members of the other workgroups. Indeed, the Senior Team members average about twice as many tasks per day as members of the other workgroups.

7.2.2 Interactants per day. Figure 7.3 illustrates the number of distinct interactants per day with whom workgroup members interact. This is an *unduplicated* count of the individuals with whom group members met face-to-face, talked on the telephone, received a letter from or sent a letter to, and so forth. If a person attended a meeting with four individuals first thing in the morning, the count would be increased by four; if that person talked on the phone with one of those individuals later in the day, the unduplicated count would not increase.

Members of the Senior Management on the average interact with far more distinct individuals per day than do members of the other groups. In section 7.5 below, some related measures of breadth of interactional or contact networks for these workgroups will be considered.

7.2.3 Relationship between the two measures. The Senior Management Team members interact with a significantly larger number of individuals per day than do members of the other workgroups. There is little overlap among the per day measures for individual members of one of the Senior Management Team and the measures for individual members of the other workgroups. These relationships can be seen in Figure 7.4, in which individuals' average number of tasks per day are plotted against their average number of distinct interactants per day. Each point in the scatter plot is an individual member of one of the three workgroups. The groups are plotted with distinct symbols. The distinctiveness of the Senior Management workgroup can readily be seen in terms of these activity measures. Although the shape of the scattergram indicates a positive correlation between these two measures of an individual's activity, the figure also indicates that the two measures are substantially independent; for a given number of tasks per day, there is quite a range of number of interactants per day, and vice versa. Intuitively this makes sense; an individual may be busy in terms of number of tasks or in terms of number of interactants, or both.

In terms of these surface measures of the activity of workgroup members, then, members of the Senior Team clearly tend to be involved with more tasks and with more interactants. This higher level of activity should not be over-interpreted at present; additional analyses presented below will enrich our understanding of these workgroup differences.

7.3 Work Activities

In this section, the examination of the microstructure of time and activity begins. Parallel sets of data will be scrutinized which pertain to three aspects of the fine temporal structure of activity: the number of observed episodes comprising an activity, the aggregate time across the episodes constituting an activity, and the mean or average duration of those constituent episodes. Although these three ways of assessing time are closely interconnected, they offer somewhat distinct perspectives on the fine temporal organization of activity.
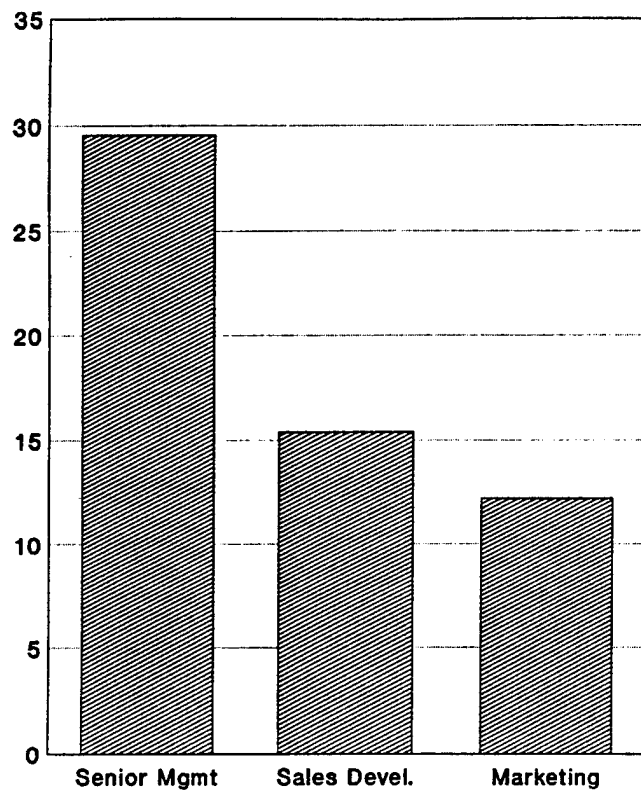
Figure 7.2   Tasks per Day
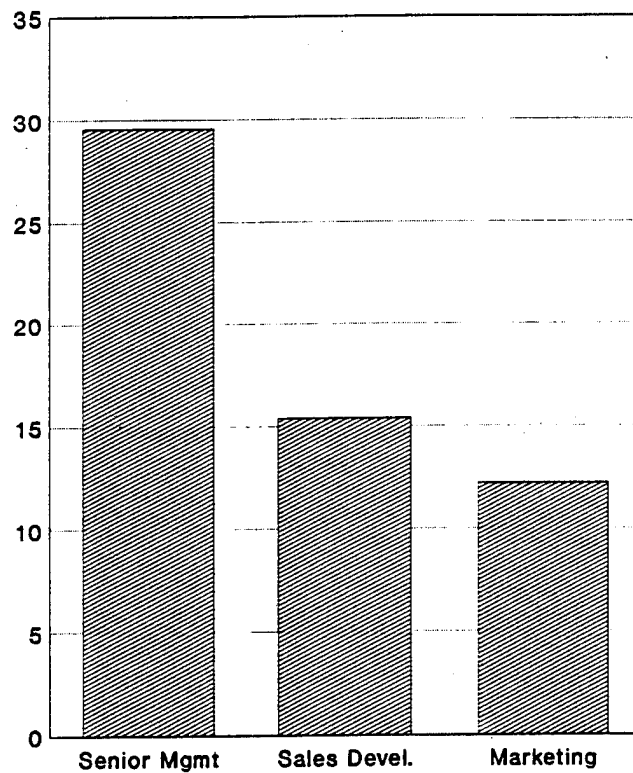
Figure 7.3   Distinct Interactants per Day
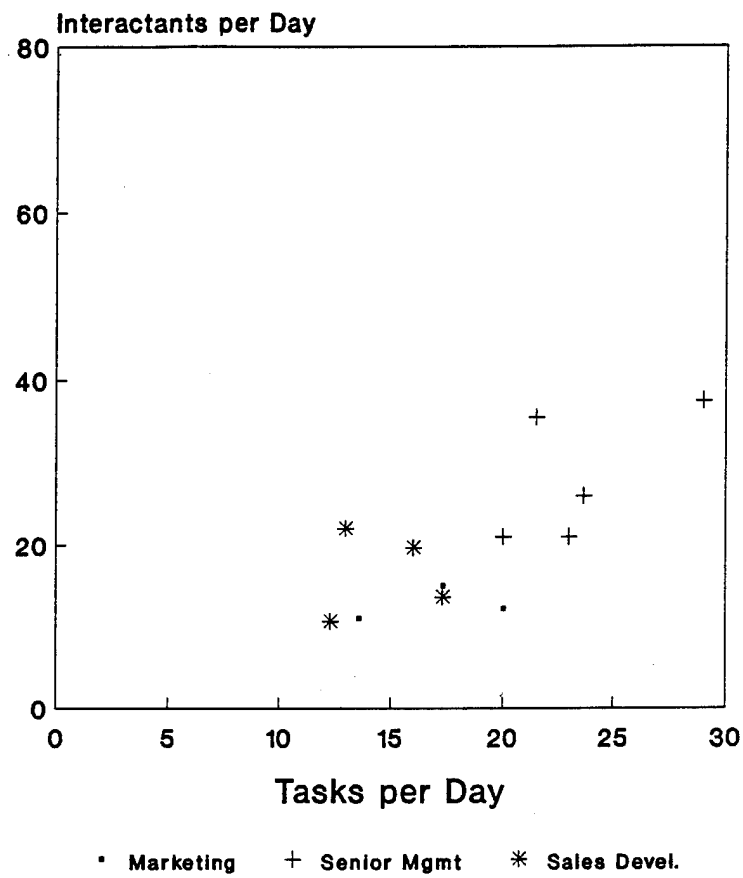
Figure 7.4   Scatter Plot of Tasks/Day x Interactants/Day

Figures 7.5, 7.6 and 7.7 display, in data aggregated across workgroups, the distribution of work activities into four categories: solitary work, face-to-face communication, telephone communication and communication through other channels (including both written communication as well as the "new" communication channels of electronic mail, voice mail and fax). Figure 7.5 displays the percentage of episodes falling into each of these categories, whereas Figure 7.6 shows the corresponding distribution in terms of percentage of time. Figure 7.7 shows the mean duration (in minutes) for episodes in these four activity categories. These analyses are based on 1482 simple and compound episodes; 228 compound episodes were necessarily excluded from these analyses because they involved a mixture of two or more of these activity types[5].

7.3.1 Overall distributions of activity. Figure 7.5 indicates that, overall, about 39% of the episodes are solitary work, 29% are telephone communication, 21% face-to-face interaction, and the remaining 11% of the episodes are communication through other channels. Turning now to Figure 7.6, which displays the distribution of aggregate time encompassed by the episodes counted in Figure 7.7, the picture changes substantially. Although the percentage of solitary work (top section) remains about the same at 39%, the relative proportions of face-to-face and telephone communication change; in terms of time, there is more face-to-face (40%) and less telephone (17%), whereas in terms of episodes, there is more telephone (29%) and less face-to-face interaction (21%). Furthermore, the relative proportion of communication through other channels decreases as we move from percentage of episodes (11%) to percentage of time (4%).

The relationship between the episode and time distributions can also be seen in Figure 7.7, which shows the mean duration of each type of episode. Clearly, the face-to-face interactions have the longest average durations (more than 13 minutes), whereas the other communication channels have much shorter durations (on average about 4 minutes for phone and under 3 minutes for other channels). Solitary work is conducted in episodes averaging about 7 minutes.

As we use these types of time measures to look more closely at the structure of activities, it is important to keep in mind the overall relationships among these measures, and to remember that any two of the distributions determines the third. In general, as we go through the data, we will find the time distributions the singly most useful of the three. We shall, nevertheless, continue to present the three parallel measures as we progress through the data.

7.3.2 Distributions across workgroups. Figures 7.8, 7.9 and 7.10 break the data considered above into the three observed workgroups. Sharp differences among the workgroups can be seen in each figure. In terms of the episode distribution (Figure 7.8), the Sales Development and Marketing groups appear quite similar, whereas the Senior Management Team has a substantially smaller percentage of solitary work episodes. Other, smaller inter-group differences suggested among these episode distributions are more clearly revealed in the time distributions shown in Figure 7.9. Members of the Senior Management Team spend much more of their time in face-to-face interaction (63%) than do members of the other workgroups and much less of their time doing solitary work (16%) than do members of the other workgroups. All groups spend about the same percentage of their time on

---

[5] The 228 compound episodes excluded from these particular analyses comprise 13.3% of all observed episodes and 22.4% of all observed time. These are obviously very richly compounded episodes, whose details are of considerable interest and will be examined later.
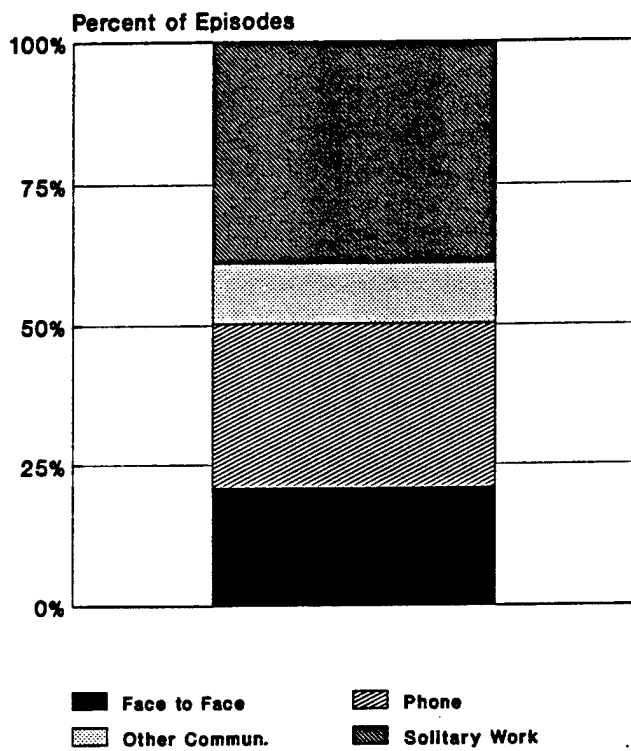
Percent of Episodes

- Face to Face
- Other Commun.
- Phone
- Solitary Work

Figure 7.5   Work Activities: Episode Distribution

Percent of Time

- Face to Face
- Other Commun.
- Phone
- Solitary Work

Figure 7.6   Work Activities: Time Distribution

Minutes per Episode

- Face to Face
- Other Commun.
- Phone
- Solitary Work
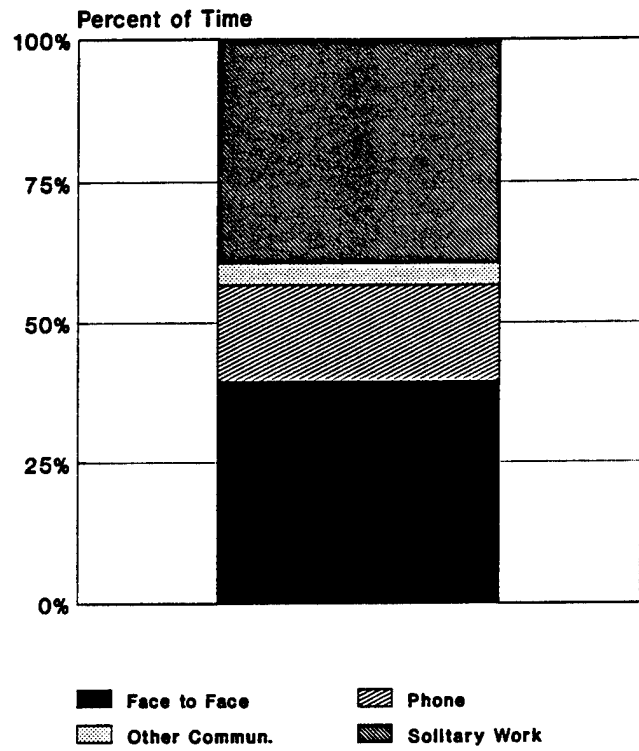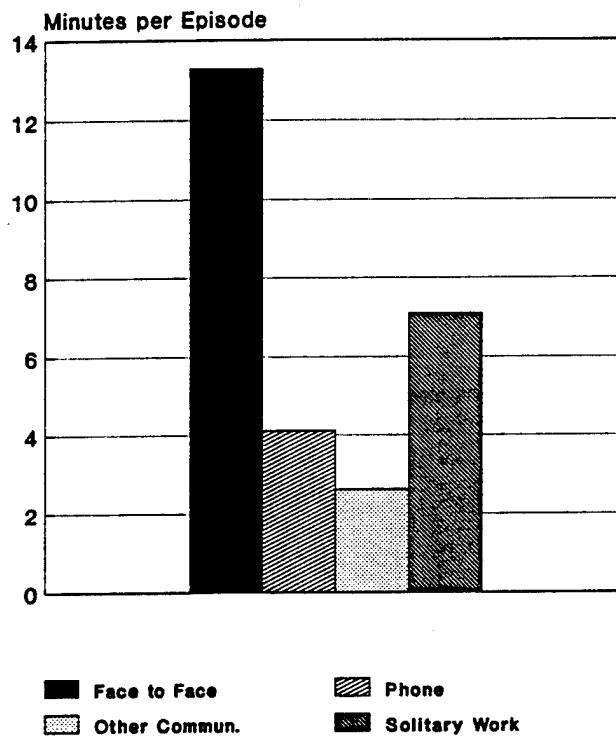
Figure 7.7   Episode Duration of Work Activities

101

Percent of Episodes
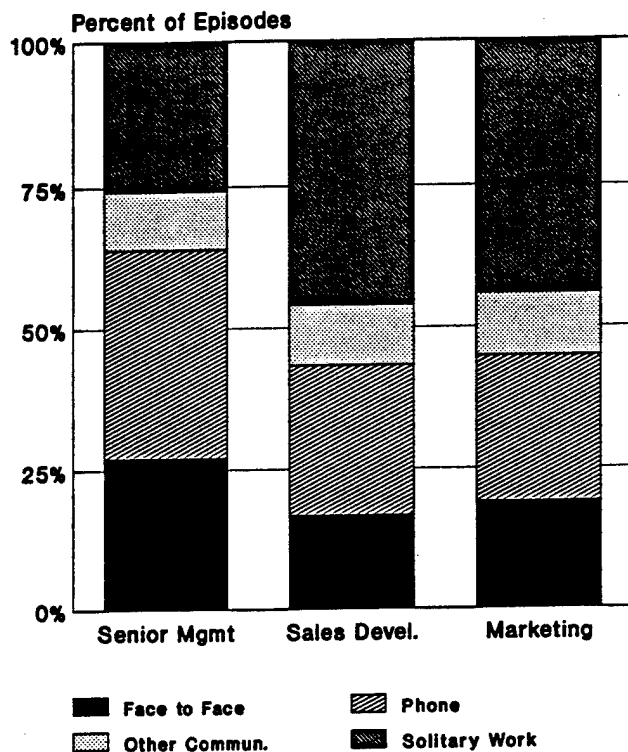
Figure 7.8   Workgroup Activities: Episode Distribution
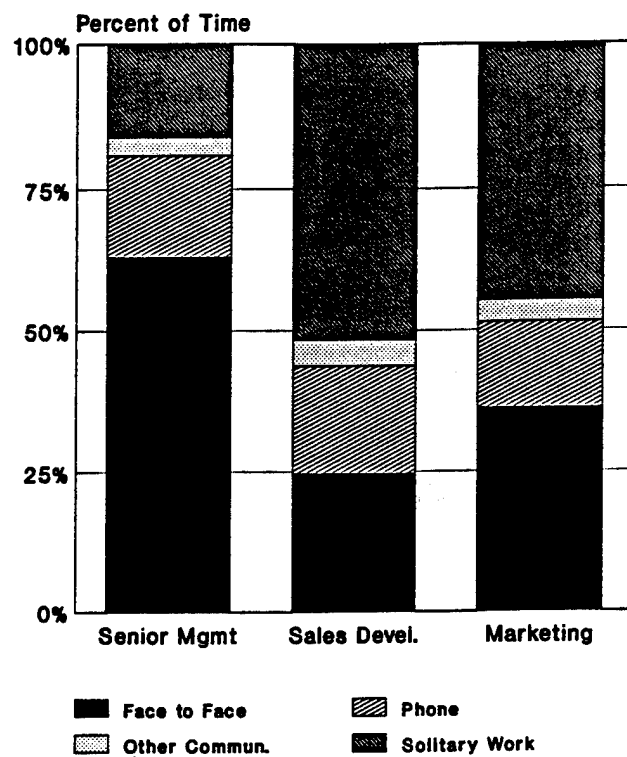
Percent of Time

Figure 7.9   Workgroup Activities: Time Distribution

Minutes Per Episode
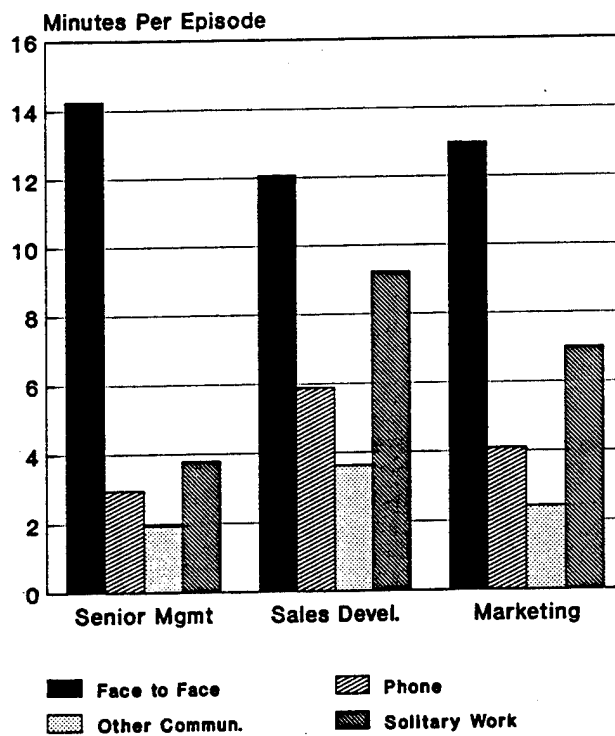
Figure 7.10   Workgroup Activities: Episode Duration

communication by telephone (15-19%) and about the same percentage of their time on communication by other channels (3-5%).

The amount of time spent in communication by members of the Senior Team (84% of their time, combining face-to-face, telephone and other channels) is consistent with other studies of executives (cf Mintzberg, 1973). Although our percentage is somewhat higher than those reported in other studies, it is based on substantial direct observation rather than on various self-report methodologies, techniques known to seriously under-estimate the extent of communication activities

More surprising, perhaps, is the lack of any observed difference among the workgroups in their use of other communication channels, including the telephone. No difference is evident in either the episode or time distributions shown above. Considering the varying patterns of dispersion which characterize the groups, and the presumed differences in their need for telecommunications for accomplishing their work, this lack of difference is somewhat surprising. In the section on channel usage below, other, more fine-grained differences will emerge in this regard.

In Figure 7.10, the mean duration of episodes for the various activities are plotted for the three workgroups. There are not many striking inter-group differences among these episode duration data. The mean duration of telephone episodes is higher for the Sales Development group (about 6 minutes on average) than for the other workgroups (about 3 minutes and 4 minutes), suggesting perhaps that the character of their telephone calls may differ from that of the other groups. But the one striking inter-group difference in the episode duration data is for the solitary work activities. Whereas the mean duration for solitary work activities is more than 9 minutes for the Sales Development and 7 minutes for the Marketing groups, the mean duration is less than 4 minutes for the Senior Management Team. Considering the start-up times necessary for complex activities like reading and writing reports, having an average of less than four minutes available at a time to complete these activities would seem to impose a formidable constraint on the type of activities which members of the Senior Management Team can carry out efficiently.

Figure 7.11 displays corresponding time distributions for individual workers. The individuals displayed in the figure are arranged by workgroups. These individual level data are parallel to those aggregated by workgroup (Figure 7.9) and overall (Figure 7.6). Differences seen in time distributions among workgroups (Figure 7.9) are evident again in these individual data. Individual members of the Senior Management group, with but one exception, spend more time in face-to-face interactions and less time doing solitary work than individual members of the other workgroups.

In Chapter 10, after reviewing all of the data, we shall consider strategies which busy managers like the members of the Senior Management Team utilize to minimize the impact of having very small time-slices in which to accomplish their solitary work in the office.

7.4 Channel Usage

In the previous section, the distribution of work activities into solitary work and communication categories was considered. In this section, we will look more closely at the communication channels which individuals use to accomplish the
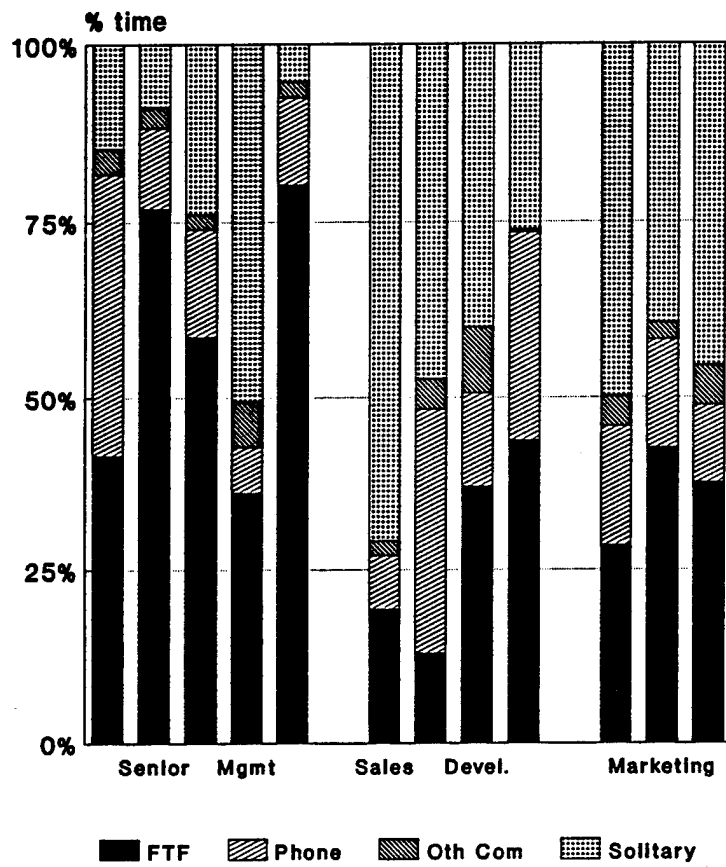
Figure 7.11 Individual Work Activities

communicative part of their work. Channels used include face-to-face, telephone, voice-mail, electronic mail, hardcopy, fax and LAN chatting. Because of the relatively low overall frequency of use of the "new" media (electronic mail, voice mail, fax, LAN chatting) in these workgroups, these channels are pooled analytically into a single channel category ("Other channels") in the analyses presented below. The contrasting channel categories, then, are *face-to-face, phone, hardcopy* and *other channels*.

The set of data examined in this section is drawn from *single-channel episodes*, i.e., simple episodes (which by definition can involve at most one channel) and compound episodes which, although they may compound multiple tasks, involve only a single channel. There are altogether 1520 single channel episodes, comprising 89% of all episodes and 79% of all episode time. The data set to be examined here is the subset of 905 episodes consisting entirely of communicative task events and involving only a single channel.

7.4.1 Overall distributions. Figures 7.12, 7.13 and 7.14 display the episode, time and duration data for the overall population of individuals shadowed. The episode distribution shows a preponderance of telephone, followed by face-to-face; the time distribution shows the opposite, with a preponderance of time in face-to-face, with telephone second. As seen above, the use of other channels (including hardcopy) is small in either distribution, but accounts for larger proportions of the episode distribution than of the time distribution. By either measure, it is clear that these workgroups do not extensively utilize channels other than face-to-face and telephone conversation for conducting their communicative work[6].

The mean durations for episodes of communication in these channels are displayed in Figure 7.14. The mean duration of face-to-face episodes is more than 13 minutes, compared to mean durations of 2-4 minutes per episode for the other channels.

7.4.2 Distributions across workgroups. These data are cross-tabulated by workgroup in Figures 7.15, 7.16 and 7.17, respectively. Slight trends noticeable in the episode distributions (Figure 7.15) are again more conspicuous in the time distributions (Figure 7.16). The Sales Development group spends less of its communicative time in face-to-face and more of its communicative time using other channels (especially telephone) than the other groups. Thus, although we previously noted that the Sales Development group did not spend more absolute time using the telephone than other groups, its members do spend a higher proportion of their *communication time* using the telephone (and other telecommunications channels).

Mean episode durations are exhibited in Figure 7.17. As noted before, face-to-face interactions have similar durations across the three workgroups, much longer than those of the other channels. Telephone and hardcopy communication episodes appear to have longer average duration for the Sales Development Group than for the other groups.

---

[6]   It is important to note again, as explained in Chapter 3, that observers distinguished between direct communication in a channel such as hardcopy -- in which, for example, a letter was composed or read as it was received -- and non-communicative uses of the channel, e.g., reviewing a previously read/filed report or letter. Although this is somewhat of an artificial distinction, and varies across channels, experiments with the operational definition in our data analyses did not interact with the major findings.

Face to Face   Phone

Hardcopy   Other Channels
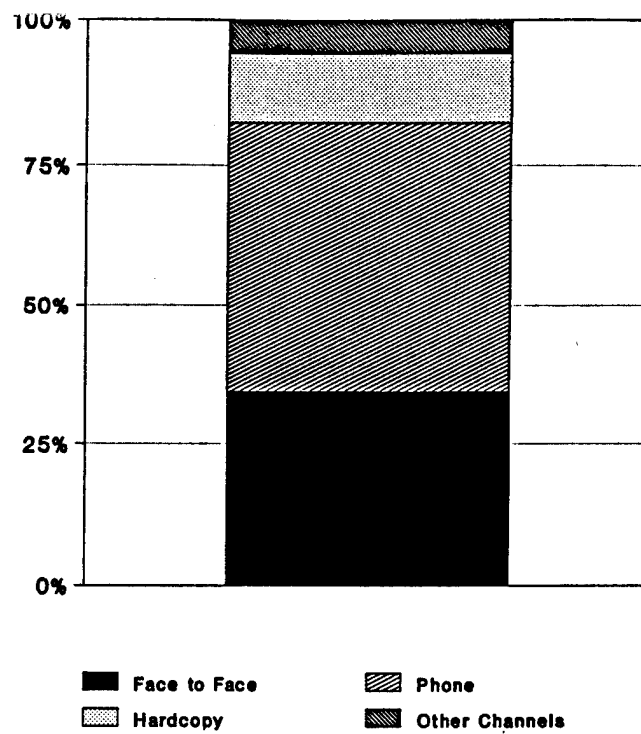
Communicative episodes (N=905)

Figure 7.12   Episode Distribution of Communication

Face to Face   Phone

Hardcopy   Other Channels
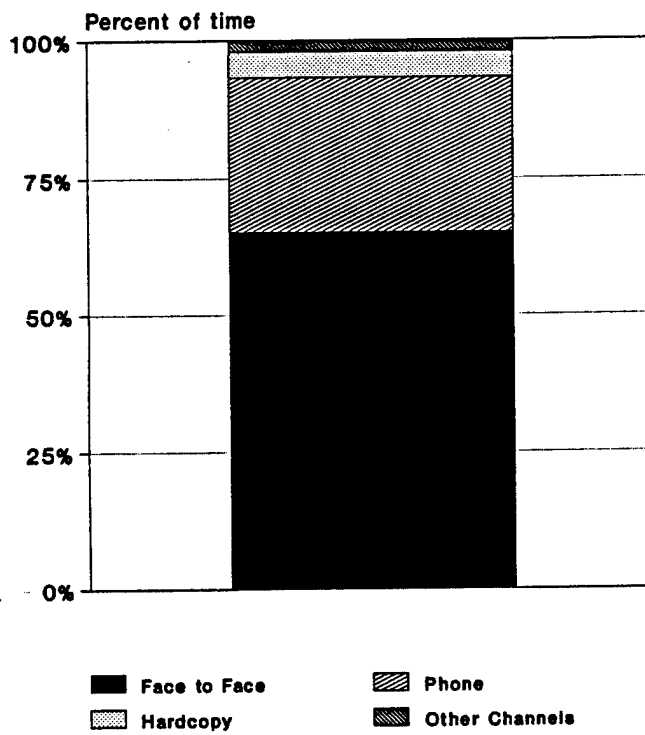
Communicative episodes (N=905)

Figure 7.13   Time Distribution of Communication

Face to Face   Phone

Hardcopy   Other Channel
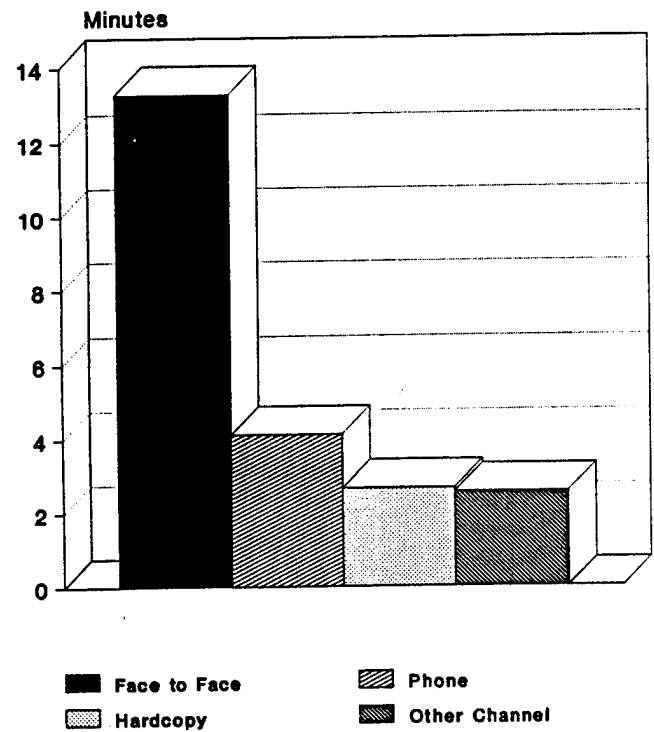
Communicative episodes (N=905)

Figure 7.14   Episode Duration of Communication

Percent of episodes
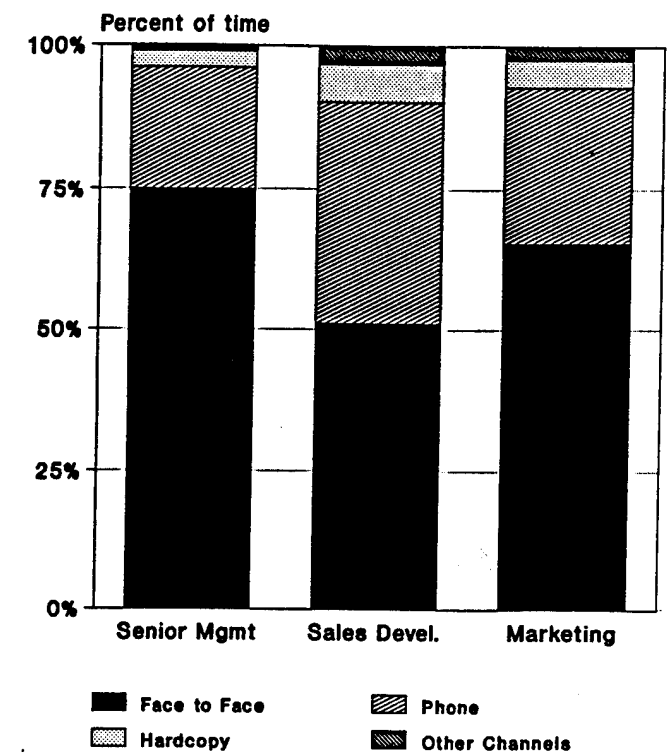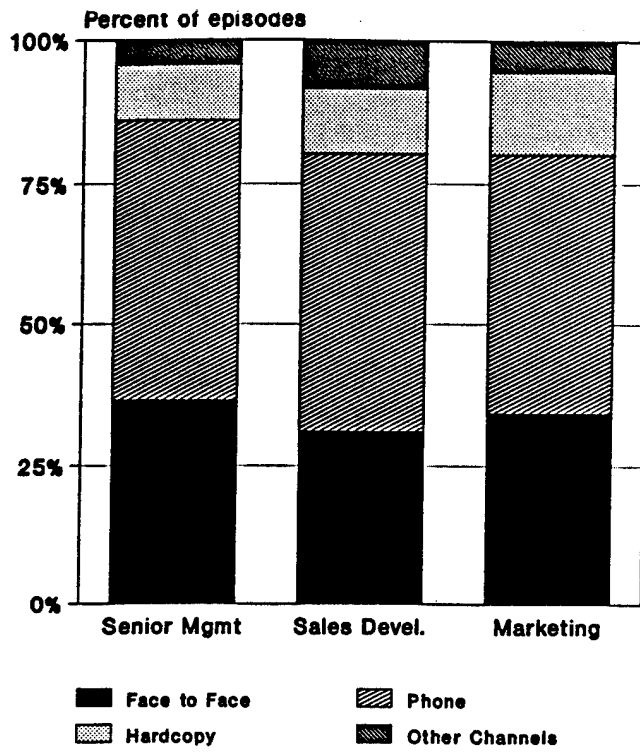
Figure 7.15   Workgroup Communication: Episode Distribution

Percent of time

Figure 7.16   Workgroup Communication: Time Distribution

Minutes
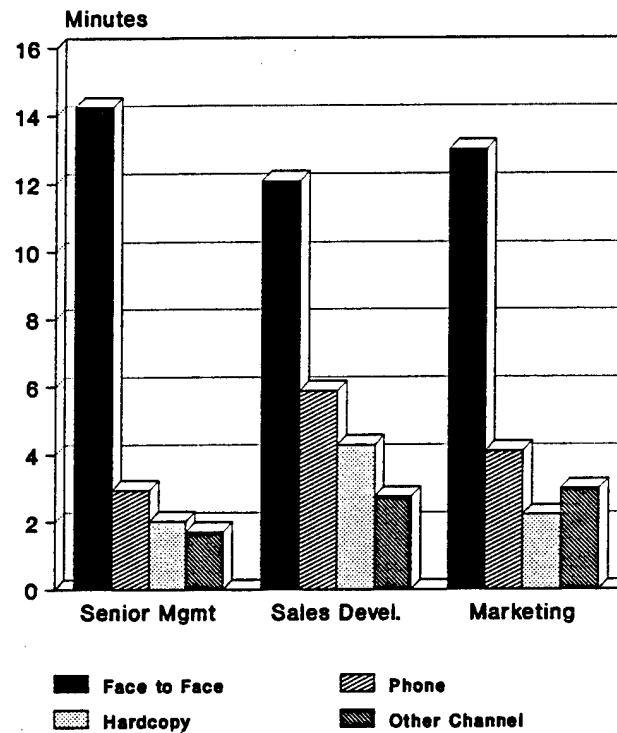
Figure 7.17   Workgroup Communication: Episode Duration

107

7.5 Breadth of Interaction

The number of distinct interactants per day was considered in section 7.2.2 as a basic measure of individual activity. In this section, the measure is extended in several ways to examine the breadth of interaction of individual workgroup members (i.e., an unduplicated count of the individuals with whom someone interacted over the course of their observed activities). This measure can be computed for interactions as a whole, or independently calculated for each channel through which interactions occurred (e.g., face-to-face conversation, telephone, etc.).

7.5.1 Breadth of interaction by channel.

Figure 7.18 displays the unduplicated counts of interactants enumerated for observed interactions through face-to-face, telephone. and hardcopy. The unduplicated combined count for all channels is also shown in the figure. The telephone is a slightly broader channel in these terms than face-to-face interaction; both are considerably broader than hardcopy interaction. The fact that the unduplicated count for all channels is substantially higher is a measure of the *non-overlap* among the interaction networks of these channels. If there were perfect overlap among the interaction networks of these channels, then the all-channel count would be no larger than the largest count for any one channel.

7.5.2 Breadth of interaction for individual workgroups.

These enumerations were made separately for each of the three studied workgroups. The results are displayed in Figure 7.19. The same pattern seen in the combined data in Figure 7.18 is apparent for each of the three workgroups when considered separately.

Although the Senior Management Team appears in these data to have a broader network of interactants than does either of the other workgroups, care must be taken in comparing the groups in this way because these are workgroup-level rather than the individual-level data that we have usually presented, and varying numbers of individuals were shadowed from each group. However, the workgroup averages for the corresponding per-day individual-level data were presented earlier, and the same workgroup differences appeared (cf Figure 7.3).

The point to be taken from the present analyses is that individuals and workgroups access distinct interactional networks through the various communication channels at their disposal; the networks accessed through the various channels have characteristically different interactional extents (with telephone being the broadest, followed by face-to-face and then hardcopy). There is partial but far from complete overlap among the interactional networks associated with the various channels.

7.6 Organizational Communication

Having considered some of the temporal properties of using the various communication channels (section 7.4) as well as the breadth of interaction associated with those channels (section 7.5), we now look in greater detail at the nature of these communication patterns from an organizational perspective. The analyses which follow are derived from an underlying matrix of interactions between the persons shadowed and those with whom they interacted. These pairwise interactions between shadowees and interactants were cross-tabulated into a 3 x 4 x 4 matrix: shadowee's workgroup x interactant's organizational status x communication channel. Four distinctions were made among the organizational status of the interactant with respect to the shadowee: same workgroup, same

Unduplicated Interactants

Figure 7.18   Breadth of Interaction

Unduplicated Interactants
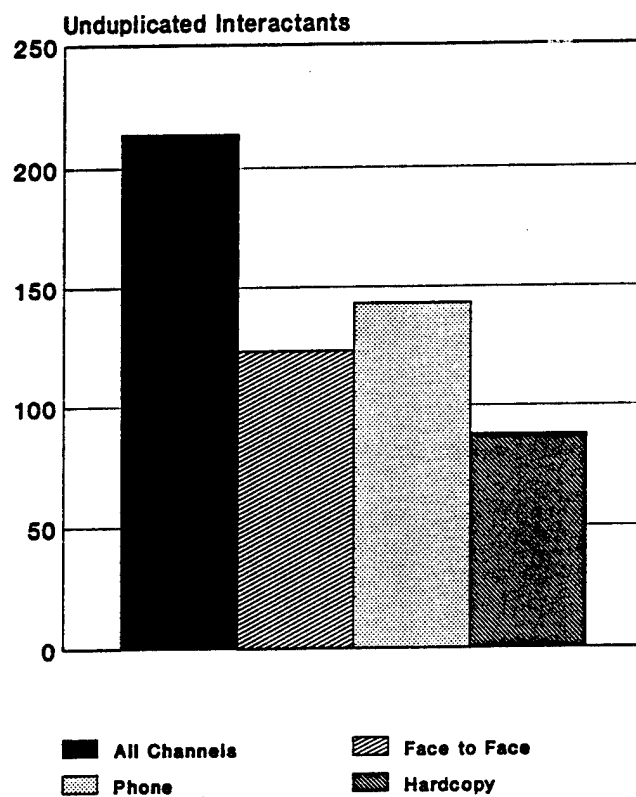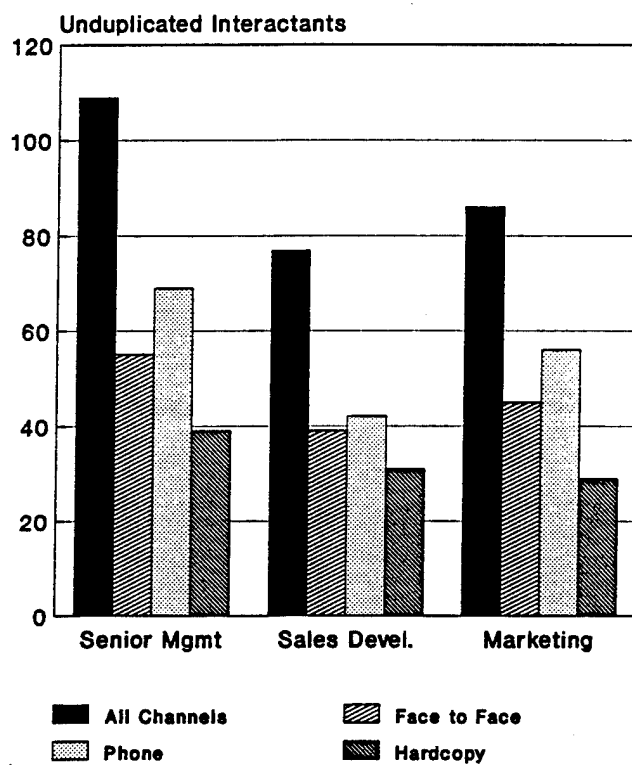
Figure 7.19   Breadth of Interaction in the Workgroups

division (but not same workgroup), same company (but not same division) and external (customer, business partner, etc.). Four categories of channels were distinguished in these analyses: face-to-face, telephone, hardcopy, and other channels[7].

Interactions between the shadowee and a given person were counted on a *per episode* basis. Thus, if the shadowee met with a person and discussed three topics during the meeting, only 1 interaction would be counted (although three tasks may have comprised the compound episode). If, on the other hand, the shadowee discussed a topic with four other persons during a meeting, four separate interactions, each between the shadowee and one of the other participants, would have been counted. If the shadowee later met privately with one of the participants, an additional interaction would be counted. In all, 2210 interactions were classified and counted in this manner[8].

The raw frequencies of interaction are displayed in a 3 x 4 x 4 table in Appendix B. The figures presented in this section (and the like-numbered tables in Appendix A) are all derived from this basic matrix of interaction frequencies[9].

7.6.1 Communication between workgroups and other organizational units. Figure 7.20 displays the percentage of each workgroup's interactions with individuals at varying organizational "distances." Perhaps the most remarkable aspect of this figure is the general similarity of the distributions for the three workgroups. The overall similarity seems all the more remarkable when we recall that the different groups have widely different needs for and constraints on communicating with others, e.g., with members of their own group (consider, for example, the wide variations among the groups in terms of their size and extent of geographical dispersion). We will see profound differences among these workgroups when the same underlying data are profiled in different ways below. We can only speculate at this point about how to interpret the general similarity of the three groups' profiles in these charts (despite some relatively small differences in details). One possibility is that the strong sense of group identity felt by members of each workgroup (despite extensive geographical dispersion and infrequent face-to-face meetings in the case of the Sales Development group) requires a minimum density of communication (through whatever channels) within the workgroup relative to communication with other organizational units.

7.6.2 Channel usage patterns in organizational communication. The distribution of communication (in terms of percentage of interactions) across organizational levels for each of the three primary channels is displayed in Figure 7.21. Interactions through each channel are counted for each of the four types of organizational communication: intra-group, intra-division, intra-company and external. Most of the interactions within each channel are at the intra-division level, that is, with members of the same division other than the immediate workgroup.

The face-to-face channel is used extensively for the organizationally-closest communications, those within the immediate workgroup or division. Overall, hardly

---

[7] The newer channels, such as electronic mail and voice-mail, were used relatively rarely by these workgroups; they were therefore combined into a single "other channel" category for purposes of these analyses.

[8] A few observed interactions were excluded from this analysis because the identity or organizational status of the interactants could not be determined.

[9] Data about the durations of these interactions were not used in these analyses because of the difficulty of allocating "time" to pairwise interactions when more than two persons are present (as is often the case in long meetings).

Percent of interactions
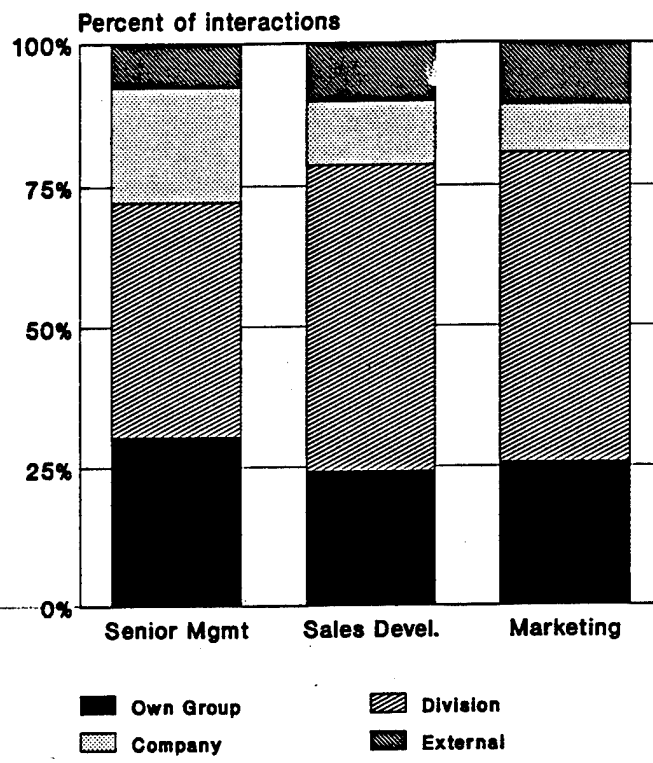
Figure 7.20   Organizational Communication by Group

(N=1015)

Percent of interactions
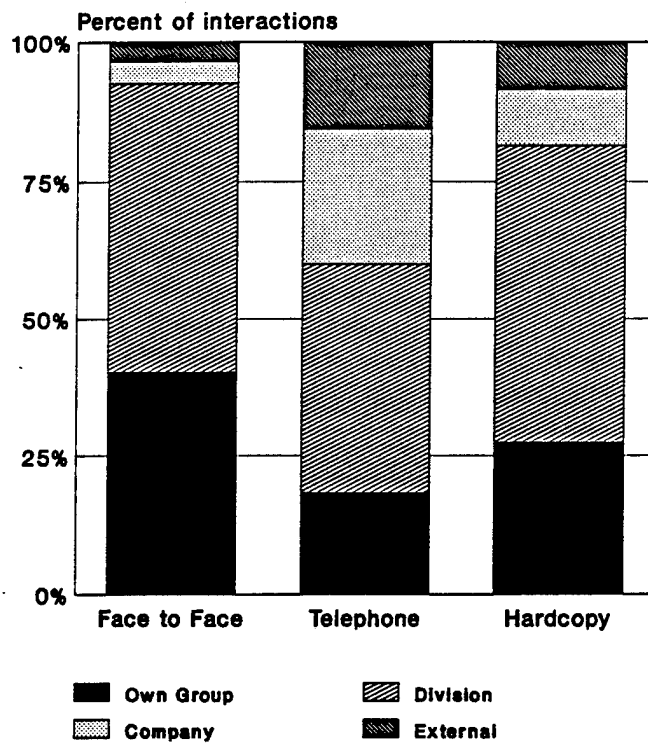
Figure 7.21   Organizational Communication by Channel

(N=2210)

any of the face-to-face communication serves organizationally distant communication, i.e., with individuals outside of the division or outside of the company (although, naturally, those infrequent face-to-face contacts may be very important). The telephone, on the other hand, seems to serve all organizational distances of communication in a relatively balanced way. Notice that for each category of interaction, the value for the hardcopy channel is intermediate between those of the face-to-face and telephone channels. Viewed in this way, the use of hardcopy -- an asynchronous channel -- is intermediate between telephone and face-to-face, two synchronous channels.

7.6.3 Workgroup-specific patterns of channel usage in organizational communication. Some sharp differences among the workgroups can be seen in Figure 7.22, in which each workgroup's channel usage pattern is displayed for each of the four types of organizational communication: intra-group (Figure 7.22a), intra-division (Figure 7.22b), intra-company (Figure 7.22c) and external (Figure 7.22d). Looking first at channel usage patterns for intra-workgroup communication (Figure 7.22a), a clearcut difference can be seen between the Sales Development group and the other two groups. Whereas the two groups with collocated members rely heavily on face-to-face communication and very little on telephone communication within their groups, the spatially dispersed group displays the opposite pattern: heavy reliance on telephone and little usage of (or opportunity for) face-to-face communication. For both of the collocated groups, usage of the telephone is significantly less than use of hardcopy (whose use is quite small in the dispersed group).

Differences among the workgroups' channel usage patterns, evidently quite profound in intra-group communication, all but disappear as we consider interactions between workgroup members and organizationally more remote individuals. In Figure 7.22b, which display the workgroups' channel utilization patterns for interactions with other members of their division, only slight differences appear among the workgroups. Each group mixes roughly equal percentages of face-to-face and telephone communication, with secondary amounts of hardcopy and "new" channels. We do note an apparent increase in the overall level of "new" media usage in these communications compared to the intra-group levels.

Turning to still more organizationally remote communications, those between workgroup members and other members of their company (but not their division), we see some similarities among the workgroups' channel usage patterns. The telephone is the primary channel for each group to communicate with members of other divisions in the company. Furthermore, the utilization of the "new" channels (fax, electronic mail and voice mail) continues to increase here, continuing the trend noted in panel (b) of the figure; in each workgroup, these other channels have surpassed face-to-face in frequency for these organizational communications.

Comparing now the intra-division with the intra-company patterns (Figures 7.22c and 7.22b, respectively), we can see that as communications become organizationally more remote, there is less reliance on (and no doubt less opportunity for) the face-to-face channel and more on telephone and the newer media. When we further broke down these interaction patterns according to whether the workgroup member and interactant were located in the same city or not, sharp patterns again emerged. Of the interactions between workgroup members and other divisional staff, 76.2% were in the same city, compared to only 9.4% of the interactions with non-divisional company staff. And 90.2% of all observed face-to-face meetings were between individuals based in the same city.

112

Percent of interactions
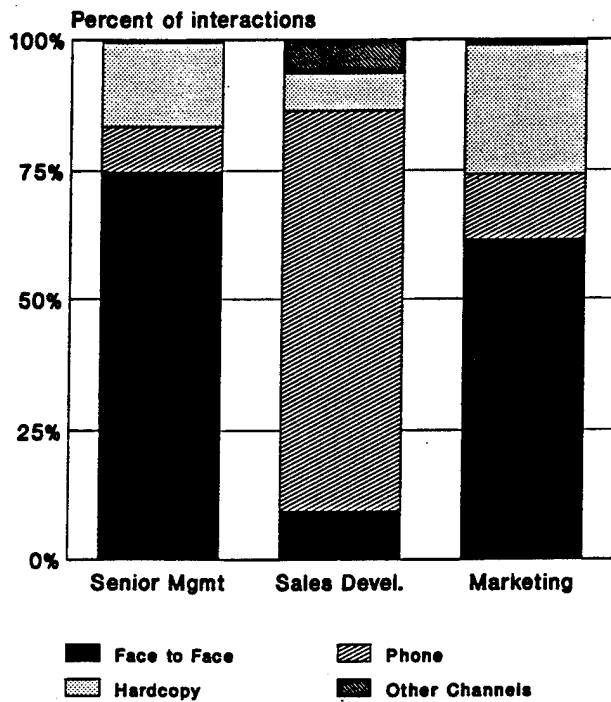
Figure 7.22a Channel Usage in Organizational
Communication: Intra-Group

Percent of interactions
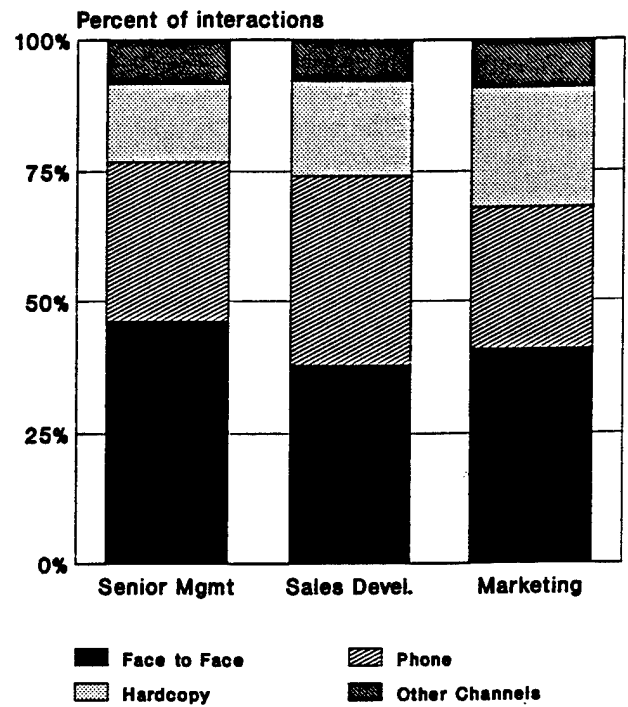
Figure 7.22b Channel Usage in Organizational
Communication: Intra-Division

Percent of interactions
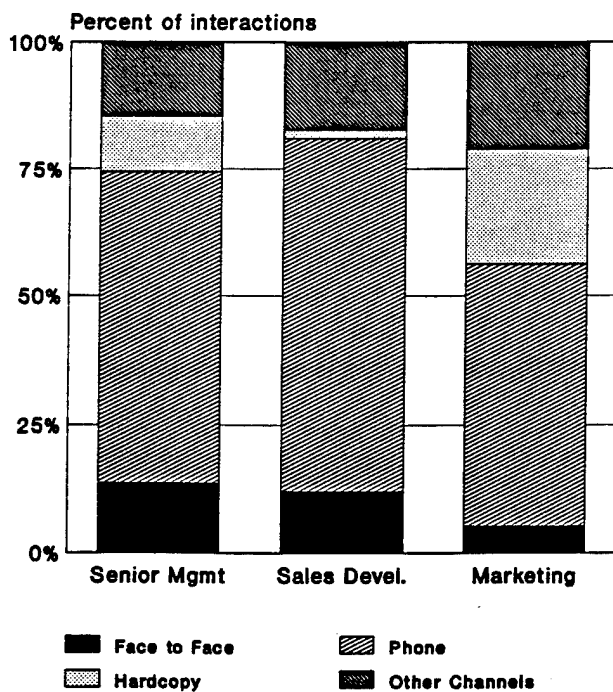
Figure 7.22c Channel Usage in Organizational
Communication: Intra-Company

Percent of interactions
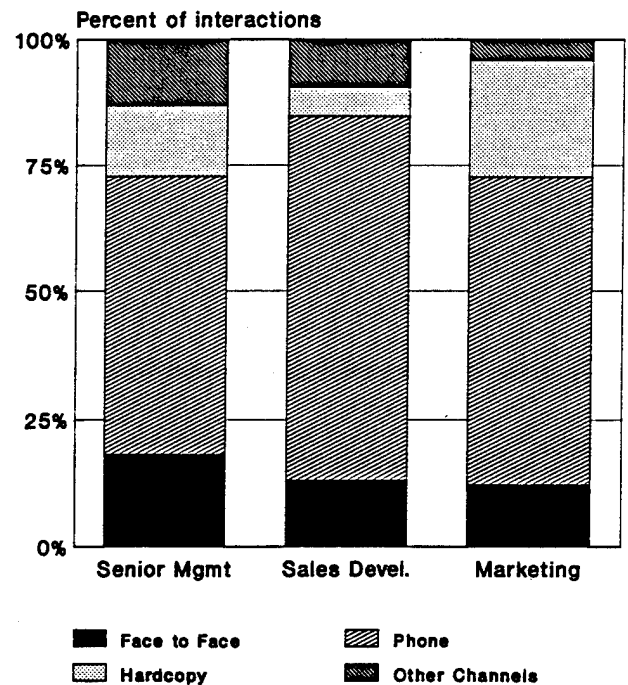
Figure 7.22d Channel Usage in Organizational
Communication: External

113

The final panel of Figure 7.22, Figure 7.22d, shows the channel usage pattern for communications between workgroup members and individuals outside of the company (who were typically customers, vendors, or [potential] business partners). As with intra-company communications, there is heavy reliance here on telephone and relatively infrequent use of face-to-face communication[10]. There also seems to be an across-the-board increase in the frequency of written materials in these communications.

7.6.4 Workgroup communication patterns. Figure 7.23 displays sharp contrasts among the three workgroups' patterns of channel usage to meet their communication needs. Parallel displays are shown for the Senior Management (Figure 7.23a), Sales Development (Figure 7.23b) and Marketing (Figure 7.23c) workgroups. The two geographically collocated workgroups, the Senior Management and Marketing teams, exhibit relatively similar patterns of channel usage as they conduct their communicative activities, patterns quite distinct from that of the geographically dispersed workgroup, the Sales Development Group. The primary difference concerns the extensive use of face-to-face (and hardly any telephone) for intra-group communication among the geographically collocated groups and the opposite pattern for the geographically dispersed workgroup.

7.6.5 Trends in channel usage. In Figure 7.24, data from the three workgroups are again pooled to yield a view of how the various channels are deployed for communication with individuals at varying organizational distance. Looking at the trend as we move from left to right across the three leftmost bars in the figure (from Own Group to Division to Company), we see several orderly trends that appeared in some of the previous figures. First, there is a systematic decrease in the reliance on face-to-face communication. Second, there is a corresponding increase in the use of telephone. As seen in the previous sets of data, there is a fairly regular tradeoff here between use of face-to-face and telephone conversations. Third, a decrease in hardcopy is offset by a sharp increase in the use of the "Other" (i.e., "new") communication channels as we move across the firth three bars, the range of organizational distance. Thus, we see a tradeoff among the asynchronous channels (hardcopy and the "new" channels) as well as a tradeoff among the synchronous channels (face-to-face and telephone).

Of particular interest is the suggestion in these data of how use of the newer media is being introduced into this setting. Rather than being used for intra-group communication, these "leading edge" technologies are finding early uses as communication channels for more organizationally distant communication. Perhaps this reflects a "top-down" implementation process from an organizational point of view. This pattern certainly suggests good starting points for internal implementation and support of these technologies.

7.7 Interactional Chains and Channel Switching

Cooperative work is often accomplished in part through a series of interactions among collaborating participants. The periods of solitary work which individual participants devote to accomplishing their parts of a cooperative task are

---

[10] This is not to say, of course, that face-to-face contacts with customers, business partners or others were unimportant components of the overall communication; many of these interactions took place out of our observation, e.g., during travel periods.

Percent of interactions
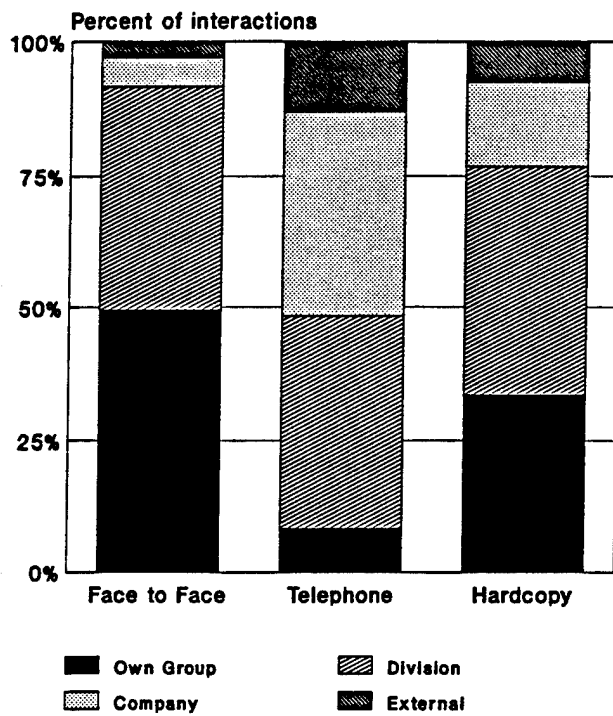
Figure 7.23a

(N=1015)

Organizational Communication: Senior Management

Percent of interactions
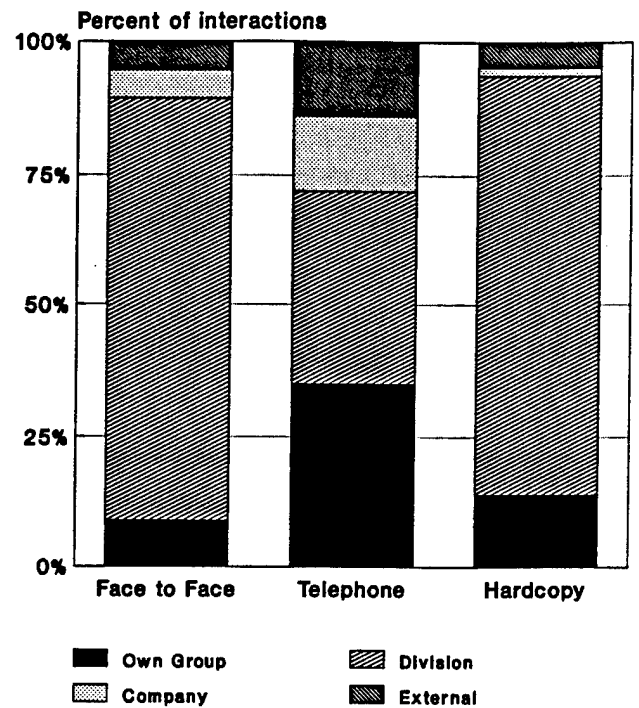
Figure 7.23b

(N=519)

Organizational Communication: Sales Development

Percent of interactions
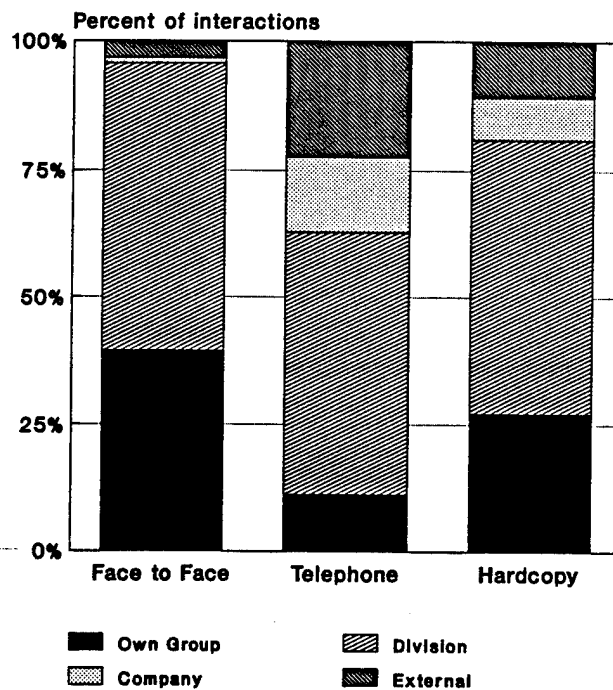
Figure 7.23c

(N=676)

Organizational Communication: Marketing

115
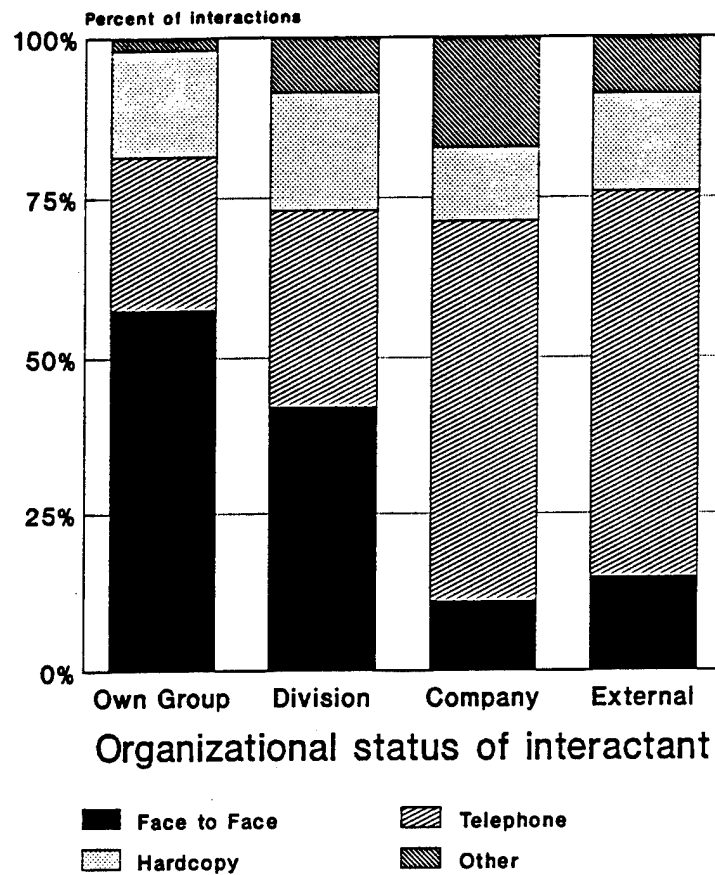
Figure 7.24   Organizational Communication by Interactant's Status

intertwined with meetings, the exchange of written information and other interactions among task participants.

Communication plays a crucial role in the collective accomplishment of these cooperative activities. Communication is a means through which individuals structure, manage and coordinate the individual activities comprising the collective endeavor. Communication is also part and parcel of the interactive process through which substantive collaboration occurs in group action.

To highlight the role of communication in the observed activities of the studied workgroups, the concept of *communicative chains* was developed. A communicative chain is operationally defined as a sequence of distinct interactions between the same individuals on a given task. In our observational data, such chains are identified as a series of communicative events (within the same day) between the shadowee and another given individual (or set of individuals) pertaining to a particular task. Many such sequences include events over multiple days, of course; our analyses, however, are limited to those parts of such chains which could be observed within a given day of observation[11].

Figure 7.25 displays the occurrence of such communicative chains in the observation data. The frequency of the chains is plotted as a function of the chain length. Such chains are fairly frequent overall, considering the fact that we are here examining only a small (within-day) segment of the totality of ongoing chains. Not surprisingly, as the length of the chains increase, their frequency diminishes (within a single-day frame of observation). If we next look at the channels used in the constituent communicative events ("links") of these chains, and calculate the number of chains which involve a *channel switch* (e.g., from telephone to face-to-face) from one link to the next, the results can be plotted as shown in Figure 7.26. When the chain length is only two communicative events, nearly 50% of the chains involve a channel switch. As chains progressively lengthen, the percentage having a channel switch steadily increases as well, rising to 80% by length four.

Overall, 60.2% of all communicative chains involve a channel switch. All three of the studied workgroups display curves similar in shape to that shown in Figure 7.26. The overall percentages of communicative chains that involve a channel switch for the Senior Management, Sales Development and Marketing groups are 57.0%, 62.2% and 63.0%, respectively.

These results indicate that not only are communicative chains common threads underlying the accomplishment of cooperative tasks, they involve frequent channel switches among collaborating individuals as they work together over time. Using technology--rooted in the use of a single channel (as are most current "groupware" products)--to support the group accomplishment of such tasks would not fit well with the natural activity and communication patterns of workgroups such as those studied here. The implications of this important result for the goals and design of group-friendly interfaces will be considered in more detail in Chapters 10 and 11.

---

[11] We could look at these chains over multiple days for the workgroups' key tasks (see section 7.4 above) which were observed over multiple days. We have not yet had the opportunity to perform these analyses, but plan to do so.

Task Sequence
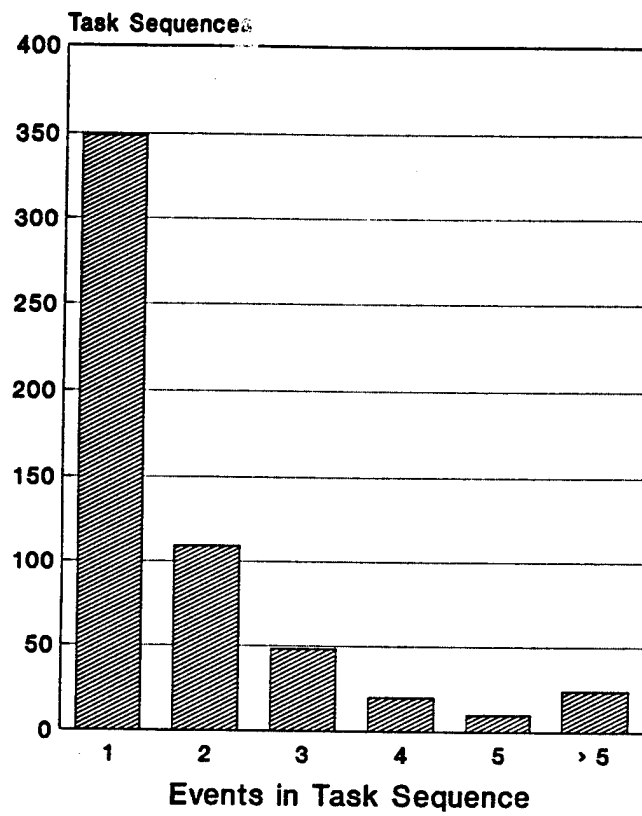
Figure 7.25   Communicative Chains
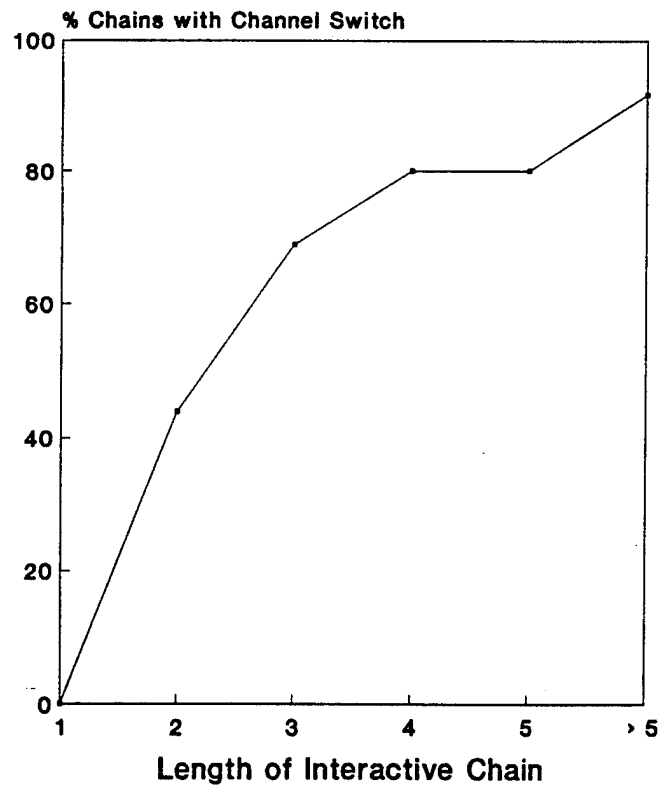
Figure 7.26   Channel Switching

118

7.8 Multitasking

Section 7.2 indicated that individuals are engaged in a large number of tasks in a given day, and interact with a large number of individuals as well. The results of the preceding section (7.7) indicate that many of these activities and interactions are structured into communicative chains, which likely crisscross each other in the temporal sequence of an individual's busy day. Mintzberg (1973) has characterized the activities of the executives he observed as having a high degree of "brevity, variety and fragmentation." This description, of course, is exactly what would be observed as an individual participates in multiple, temporally overlapping activities. To participate in multiple tasks involving other individuals, a worker must alternate between tasks on a moment by moment basis, creating a situation with which many office workers are all too familiar: having too many jobs to do at once, too many interruptions, not enough hours in the day, resulting in tasks just "getting stacked up." These observations suggest that a *multitasking metaphor* (Sproull, 1984) may provide a useful way to conceptualize and analyze the activities of individuals and workgroups.

7.8.1 Measuring task stacks.
To operationalize multitasking in our shadowing data, we defined a simple way of measuring, on an ongoing basis, the size of the activity "stack" of an individual being shadowed. The operational definition used, termed here *Method A* (described previously in Section 5.8), identifies a given task as on an individual's "stack" whenever the individual (1) is not working on it at the moment; (2) has worked on it previously in the day; and (3) works on it again later the same day. Method A has the advantage of being based entirely on observed activities, but the drawback of measuring only that fraction of an individual's task stack visible within the frame of a single day; excluded from the Method A measure are tasks that start one day and are returned to a different day, for example.

A second operational definition will be considered in Chapter 9 below. The Method A measures were computed at the beginning of each episode in the shadowing data. Both maximum ("peak") and running averages of the measure were then computed for each shadowing session. These per session measures were then averaged to yield both per individual and per workgroup measurements. The workgroup level data are presented in section 7.8.2, and the individual level data in section 7.8.3.

7.8.2 Workgroup level averages.
Figure 7.27 displays workgroup level averages of the size of individuals' task stacks using Method A. The tops of the hatched portions of the bars in this figure represent the mean peak values of the stack size for a day, whereas the tops of the solid portions represent the mean running average stack size over a day.

In the figure, sharp differences can be seen between the Senior Management Team and the other two groups. Tasks are substantially more "stacked up" for individual members of the Senior Management workgroup. Looking at the running averages portrayed by the solid parts of the bars, members of the Senior Management Team have on average twice as many tasks in their stacks as do members of the other workgroups (which do not differ in these terms).

It is important to point out that the linear scale of measurement displayed in the figure does not do full justice to the likely impact of these differences. Just as juggling four balls is substantially more than twice as difficult as juggling two balls,
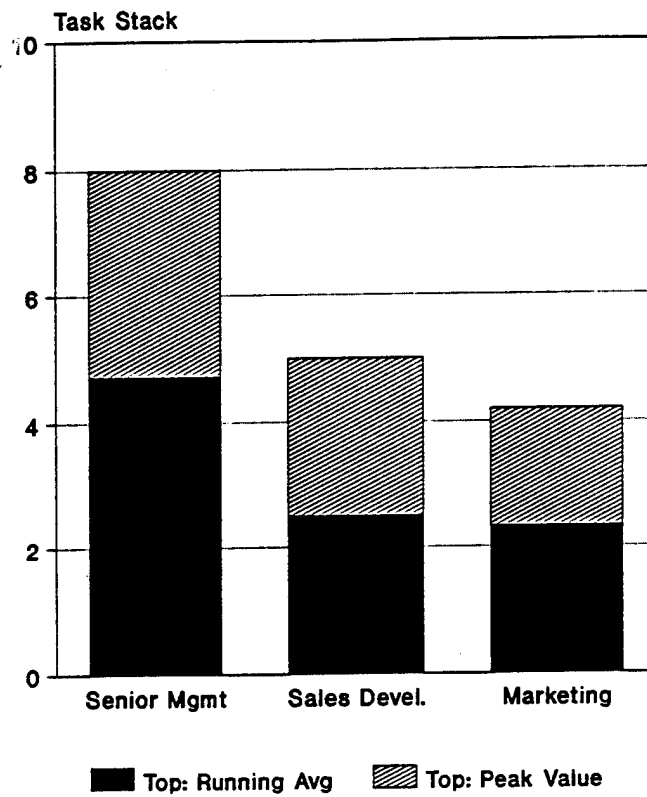
Task Stack

Note: Averaged per Day (Method A)

Figure 7.27   Workgroup Levels of Multitasking (Method A)
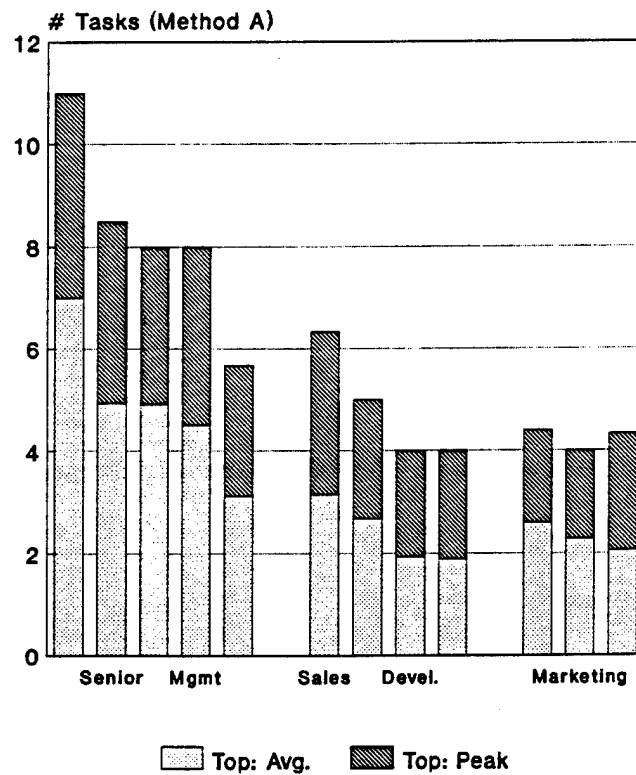
 # Tasks (Method A)

Figure 7.28   Individual Task Stacks (Method A)

120

so may "juggling" (i.e., multitasking among) four tasks be more than twice as difficult as "juggling" two[12].

7.8.3 Individual level averages. The corresponding data for individual participants are displayed in Figure 7.28. Individuals displayed in the figure are ordered by their workgroups. The substantial workgroup differences seen in the previous section are readily apparent here at the individual level. Only one member of the Senior Management Team has lower peak or average stack size than the highest-valued member of either of the other two groups. We are struck by the extent to which these data suggest the immediate workgroup may shape the multitasking among its individual members.

7.8.4 Covariation of stack size with number of tasks per day. In section 7.2.1 data were presented on the average number of tasks per day in which individual members of workgroups were engaged. Members of the Senior Management Team were involved in a significantly higher number of tasks per day than were members of the other groups. Since there is good reason to expect a positive relationship between number of tasks per day and measures of multitasking activity, the two are cross-plotted in the scattergram shown in Figure 7.29. Each point plotted is the average mean value over an individual's days of being shadowed. Members of the three workgroups are plotted with distinct symbols.

Several observations can be made about the figure. First, the distinctiveness of the Senior Management Team from the other workgroups in terms of these measures is again very clear. Second, the general shape of the scattergram reflects an anticipated positive correlation between the number of tasks per day and the average stack size for the day. Third, even though there is a positive correlation between the measures, they do measure different things. Looking at an imaginary horizontal line drawn across Figure 7.29 at Tasks/Day = 20, for example, we see a wide range of average sizes associated with a given number of tasks/day. The ways in which individuals sequence and manage a given set of tasks (i.e., their multitasking behavior) influences the size of their task stack.

7.8.5 Impact of multitasking. Although the quantitative impact of such multitasking on task performance cannot be directly assessed from these analyses, our qualitative data leaves little doubt about the generally negative impact of excessive multitasking. There are constant conversations and reminders in this environment -- and in many business environments -- about the importance of task prioritization and efficient "time management." One popular metaphor in this office involved taking the "80-20" approach, i.e., do the first 80% (of whatever), then worry about the remaining 20%. As in many office settings, there is a great deal of concern and conversation directed towards issues of time management and task prioritization.

One of the effects of excessive multitasking, of course, is to reduce the size of the time slices available for conducting a task. The substantially larger average stack size of members of the Senior Management Team seen in this section is closely linked with their markedly smaller durations for solitary work displayed above in Figure 7.10 in section 7.3.2. Those mean episode durations are the average "time slices" available for accomplishing tasks. Recalling that members of the Senior Management workgroup average less than four minutes per "time slice" of solitary

---

12 A quadratic scale might be more appropriate to characterize the relative burdens imposed by task stacks of various sizes. After further data and theory become available about the impact of multitasking on task performance, a series of measurement issues can be better investigated.

121

Tasks per Day

Mean Stack Size

• Marketing   + Senior Mgmt   * Sales Devel.
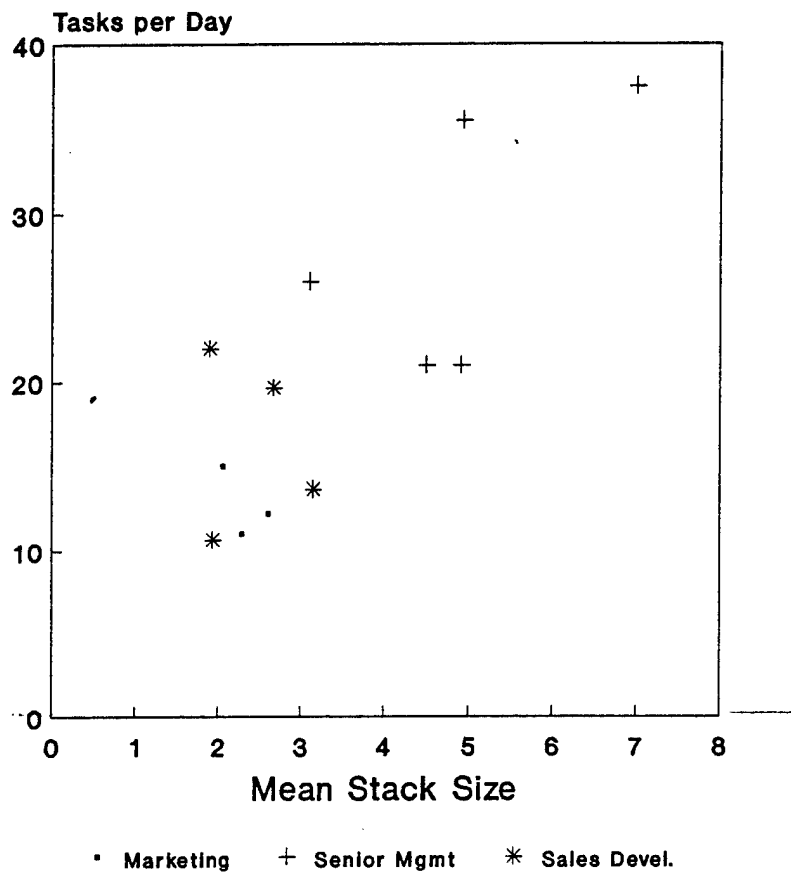
Running average (Method A)

Figure 7.29   Tasks/Day x Stack Size (Method A)

work, one can begin to appreciate the difficulties of getting some tasks done under those temporal constraints.

7.9 Self-Management Activities

Given this picture of the temporal organization of activity among workgroup members -- of multiple, ongoing and highly intertwined (i.e., "stacked up") tasks -- individuals clearly must expend considerable effort towards managing their own time and task load. As noted in Chapter 3, such activities as going through one's inbox, sorting through a stack of phone messages, reviewing one's calendar, filing a series of documents were classified as being non-task-specific. Such self-management and self-organization activities are termed here "non-specific" tasks. Their distributions across the three workgroups are shown in Figures 7.30 (percentage of episodes of non-specific activity), 7.31 (percentage of time in episodes of non-specific activity) and 7.32 (mean duration of episodes of non-specific activity)[13].

As might be expected from their higher rates of multitasking, members of the Senior Management workgroup spend about twice as much of their time on these non-specific tasks as do members of the other workgroups (Figure 7.31). These self-management activities consume about 20% of the time of the Senior Management Team members!

Another difference among these duration data is worth noting. The average duration of these non-specific activities is considerably shorter for members of the Marketing workgroup than it is for members of the other workgroups (Figure 7.32). This difference appears to be closely associated with the fewer days out of office (because of less travel) experienced by members of the Marketing group, noted in Chapter 6 (see Figure 6.2). We observed longer durations for such non-specific activities as going through one's inbox or stack of phone messages following return to one's office after having been out of town on travel; one's inbox simply "stacks up" and takes longer to work through, resulting in longer non-specific activity durations.

7.10 Summary

In this chapter the results of the shadowing study have been presented. Particular attention has been give to the contrasts among the Senior Management, Sales Development and Marketing Workgroups. Some of the significant contrasts observed among these groups relate to the structure of the work and communicative activities of the three groups. As we have seen, the Senior Management group spends more time communicating, has more high urgency, complex, and critical tasks, and juggles more tasks than do the other groups. The Sales Development team relies almost exclusively on the telephone for intra-group communication. The Marketing group spends the most time on key tasks and the highest proportion of

---

[13] In these data, a small number of compound episodes have been excluded; excluded were compound episodes in which both specific and non-specific events took place. As noted in the footnotes to the figures, these exclusions comprised only 5.6% of the observed episodes and 8.4% of the observed time.
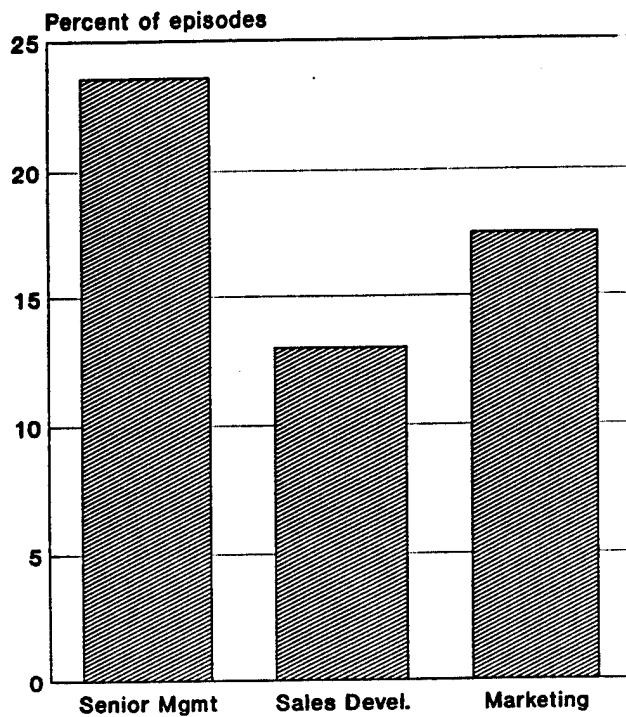
Percent of episodes
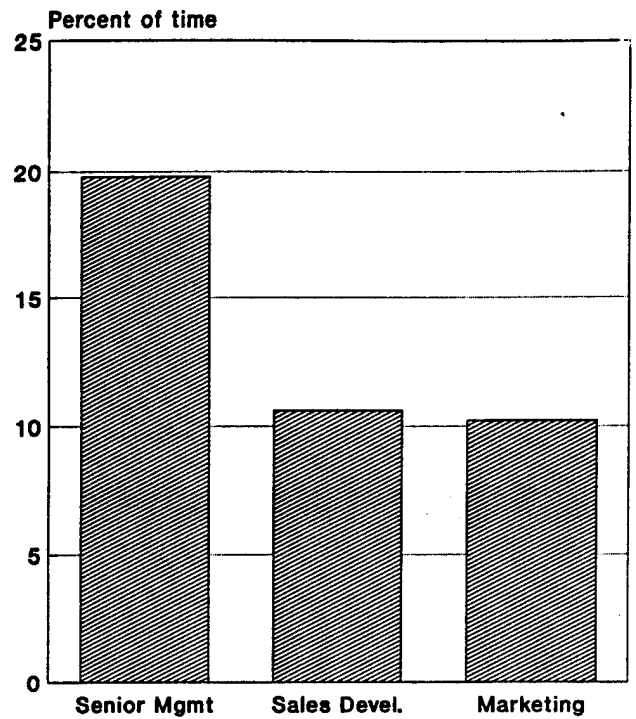
Figure 7.30   Non-Specific Activity: Episode Distribution

Percent of time

Figure 7.31   Non-Specific Activity: Time Distribution
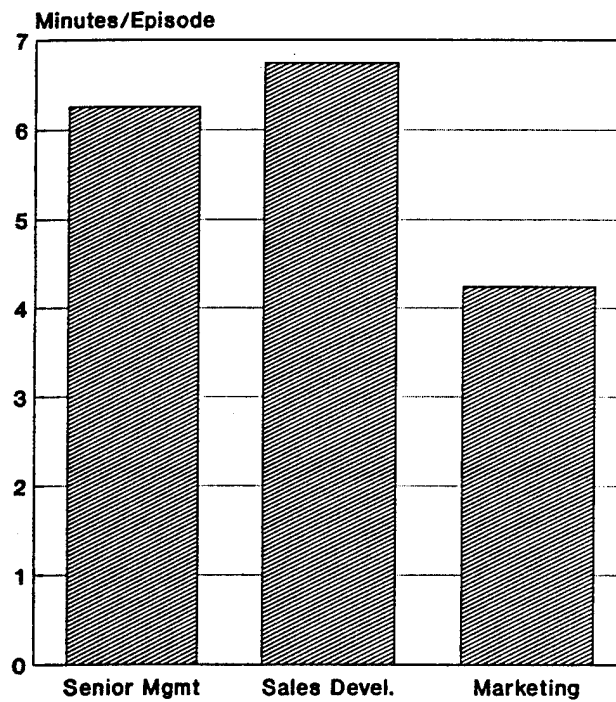
Minutes/Episode

Figure 7.32   Non-Specific Activity: Episode Duration

time working in collaboration with group members. Interestingly, there were no observed differences among the groups in use of communication channels, parallel to findings from Site 1. Additional comparisons and findings are considered in the two chapters which follow.

8.0 COMPARISON OF RESULTS FROM TWO SITES

8.1 Introduction

This chapter compares the results of the field studies in the two sites: Io Products (Chapters 4 and 5) and Parallax Systems (Chapters 6 and 7). The direct results for each site, of course, are the primary data of interest to the project. In comparing those results here, the qualitative pattern of similarities and differences observed among the individuals and workgroups across the two settings is of primary interest, rather than a formal quantitative comparison of data across the two sites. As discussed in the first chapter, no such direct comparison of the two sites was planned; the project has followed a course of grounded research about the ways in which workgroup members communicate in the course of performing collaborative work. Particular attention has been given to the communication channels used to support cooperative activities, and how temporal and spatial factors constrain the communicative choices individuals and workgroups make in accomplishing their cooperative work. Of special significance in this research is the impact that the availability and use of emerging workplace communication technologies such as electronic mail have on these patterns of communication and cooperation.

The emphasis in these comparisons will be on the quantitative aspects of the field studies, i.e., the shadowing data reported in Chapters 5 and 7 for Sites 1 and 2, respectively. Qualitative results reported in Chapters 4 and 6 will be used in this and the following couple chapters primarily to help interpret observed patterns of quantitative differences among individuals, workgroups and sites.

In presenting parallel findings from the two field studies, selected pairs of figures from Chapters 5 are presented again here in side-by-side fashion to facilitate visual comparison. The chart below indicates, for each of the comparison figures shown in this chapter, the source of the figures from Chapters 5 and 7; those figures labeled "composite" in the chart were made by superimposing (rather than displaying side-by-side) the two source figures. The corresponding raw data are tabled in Appendices A and B for figures taken from Chapters and 7, respectively.

Correspondence between Current & Previous Figures

Figure	Source Figures & Tables
8.1	5.1, 7.1 (composite)
8.2	5.6, 7.6
8.3	5.7, 7.7
8.4	5.9, 7.9
8.5	5.10, 7.10
8.6	5.13, 7.13
8.7	5.16, 7.16
8.8	5.18, 7.18
8.9	5.19, 7.19
8.10	5.21, 7.21
8.11	5.24, 7.24
8.12	5.22a, 7.22a
8.13	5.22b, 7.22b
8.14	5.22c, 7.22c
8.15	5.25, 7.25
8.16	5.26, 7.26 (composite)
8.17	5.28, 7.28 (composite)
8.18	5.31, 7.31

In the interest of brevity, discussion of the figures presented in this chapter is sharply curtailed, since the primary results have been previously considered in detail in Chapters 5 and 7. The focus here will be on describing and interpreting the comparisons of those previously considered data. Thus this chapter should not be read independently of the earlier data chapters in which the results were initially and more thoroughly considered.

8.2 General Patterns of Activity

Individuals and workgroups were engaged in different types of work in the two sites: At Io Products (Site 1), product design and engineering tasks were carried out by professional and technical workers, whereas at Parallax Systems (Site 2), high-level market planning and management activities were conducted by professional and managerial staff. Many major qualitative features of the two work environments were distinct as well: Site 1 was a casual, informal work environment; this was manifested in many ways, e.g., in terms of the physical organization of the workplace (an "open office" layout with cubicles rather than private offices), the informality of dress, the perception that individuals were free (if not encouraged) to express their individuality by personalizing their workspaces, schedules and styles of work. Individuals adhered more to professional rather than to corporate values. The "atmosphere" of Site 2, however, contrasted sharply: it was much more formal in its physical layout (and lack of personalization of individual work areas) and emphasis on established procedures and organizational values. These and many other major qualitative differences between the settings were described in Chapters 4 and 6.

Despite these profound differences, many similarities emerge across the two settings in how individuals communicate and work together to accomplish specific objectives. Similar temporal and spatial factors constrain the ways in which

individuals and workgroups cooperate to carry out basic work tasks. Communication technologies, in particular, play a vital role in the adjustment and customization of workstyles to the specific demands of the environment.

Our examination of these similarities across the two settings begins with some basic information about the temporal and spatial constraints on communication among the studied workgroups. For example, consider the extent to which individuals are readily accessible to others during the course of their workday. Many factors influence this accessibility: the extent of travel, the spatial proximity of the individuals involved (when they are not traveling), the degree of visual and acoustic isolation imposed by private offices (and secretaries), and so forth. Recall that two of the three workgroups studied in Site 2 were extensively dispersed, one group by the spatial distribution of its members' base locations, a second group by its members' frequent travel away from the headquarters. In Site 1, however, individuals were collocated in a single building and only one study participant traveled regularly. Nevertheless, when not traveling, the individuals shadowed in the two field studies spent roughly the same amount of time at their desks: an average of 69.4% and 68.7% of the working day for Sites 1 and 2, respectively.

Figure 8.1 displays a cross-plot of two basic dimensions of individuals' work activity, the number of tasks and the number of interactants engaged in a workday. Each point is an individual, plotted with symbols denoting the five studied workgroups from the two sites. These data are superimposed from those shown separately for the two sites (cf. Figures 5.4 for Site 1 and 7.4 for Site 2).

The individual variation is impressive along both dimensions, as noted previously. Putting the individuals and workgroups from the two sites together in this plot reveals the distinctiveness of the Senior Management group from Site 2 (plotted with open squares) from the other groups. Interestingly, the two individuals marked with "+"s in the top right quadrant -- who appear to cluster with the Senior Management group in terms of these measures -- are the top managers of the large Integration group. In terms of the flux of tasks and people encountered during the course of a workday, the workgroup roles of top managers (in either setting) are qualitatively distinct from those of their professional and technical colleagues. This contrast was borne out clearly in the qualitative data as well and confirms the depictions of Mintzberg (1973) and Sproull (1984). This pattern also reflects aspects of the relationship of group membership and group roles.

The style, nature of task and history of the group, for example, shape the nature of work for individuals within the group. Yet it is clear from data in both NPD and CSD that there is a fundamental role managers play within the groups in acting as brokers of information and direction for those they supervise. For example, one of the Integration team managers in NPD described his job as "running interference" for his engineers. This involved acting as a barrier between Division management and engineering staff, protecting the engineers from the bureaucracy. "Their job's essentially creative, mine's political", he said, in describing his role vis-a-vis the engineers he managed. Within the Nova Integration group there was a very clear sense of teamwork and keen awareness that only through worker cooperation was it possible to complete such a complex project, but the role of manager was viewed as fundamentally distinct from that of project engineer.

Figure 8.2 illustrates the time distributions for the basic categories of solitary and communicative activity in the two settings. (Note that email activity, which hardly occurred in Site 2 at all, is shown separately in Site 1 but is aggregated with "Other
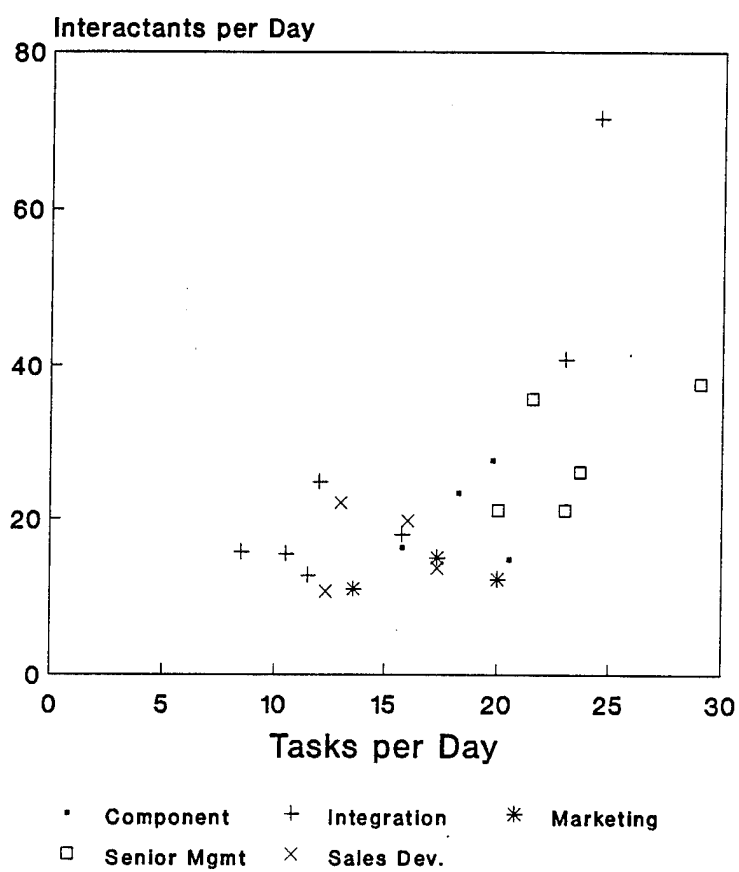
Figure 8.1   Tasks/Day X Interactants/Day
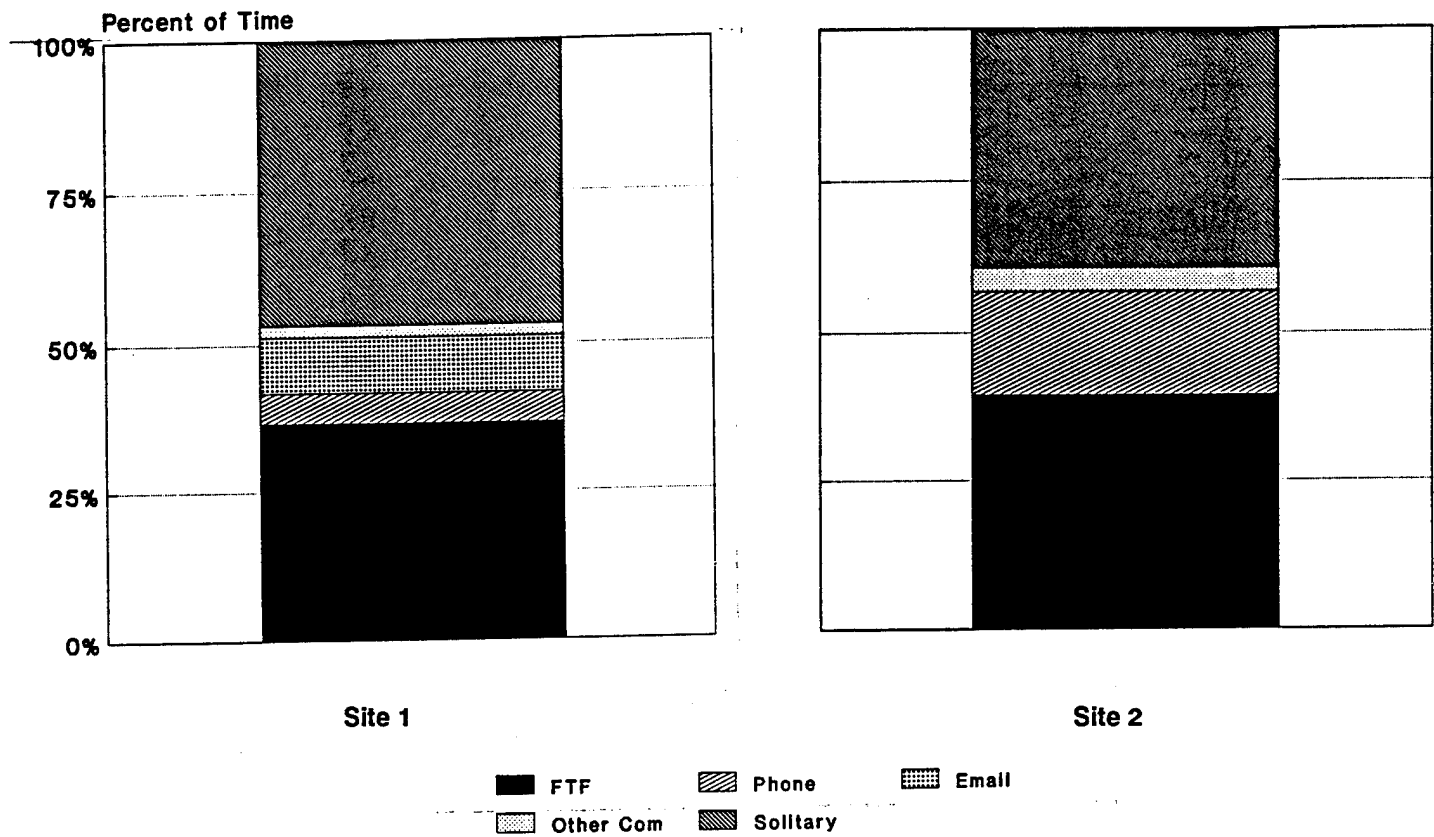
Figure 8.2   Work Activities: Time Distribution

Com" in Site 2.) Again, these are data that have been considered separately for each site before. The overall similarity is clear; individuals from the two sites spend about the same percentage of their time in face-to-face (FTF) interaction; nearly equivalent percentages of their time in solitary work at the two sites; and a smaller (but again nearly equivalent across the two settings) percentage of time in non-FTF communication, although it is realized differently in the two sites: More time is spent communicating by telephone in Site 2 and more by email in Site 1.

Figure 8.3 displays the corresponding average duration of episodes of each of these categories of activity for the two sites. Similar patterns of episode duration across the work activity categories can be seen in each site. The average duration of FTF episodes is significantly longer in Site 2 than in Site 1, reflecting the tendency towards more formally organized FTF interactions in Site 2 (e.g., a high frequency of scheduled meetings).

It seems probable that this contrast is at least partly the result of differences between the two sites in the nature of workgroup "products". In NPD, the engineers targeted for study were involved in designing, developing and engineering new products. The nature of this work was seldom dependent on extended FTF meetings. In CSD, the work of managers responsible for planning and coordinating cross-divisional efforts was the focus of study. These managers (like most managers) seldom had hands-on responsibility for "concrete" products and spent most of their time orchestrating the movement of information; the context for sharing information of this sort was the FTF meeting. Thus the longer duration of these episodes in CSD can be explained in the context of the nature of work in that environment.

The corresponding workgroup-level data are presented in Figures 8.4 and 8.5. In Figure 8.4, the temporal distribution of activities for individuals are displayed separately for the five workgroups studied in the two settings. Whereas no overall workgroup differences are evident between the two workgroups in Site 1, the three groups in Site 2 seem to differ. The differences, however, are limited to the percentage of time spent in FTF communication and solitary activity; no variation is apparent in time spent communicating through non-FTF channels. Once again the Senior Management group stands out in terms of spending relatively little time doing solitary work and an abundance of time in FTF interaction; in the most fundamental sense, face-to-face interaction *is* the work of the Senior team. The tension between the need for solitary work and the necessity of frequent face-to-face interaction with staff is handled in some interesting ways. In CSD, for example the Vice President and General Manager cultivated an "open door" policy, and encouraged employees to approach him with issues as necessary. Though workers viewed him as accessible, there was a common sense that he was extremely busy (which he clearly was) and that he should not be bothered with issues which could be handled by an intermediate manager. Thus, in practice there was the tendency for only members of his Senior Management group to take advantage of this access. Even under these circumstances he sought to control the duration of these meetings, sometimes remaining standing at his desk so as not to encourage the visitor to sit down and extend the conversation.

Figure 8.5 displays the average duration of episodes for these workgroups. For FTF communication (black bars), an overall site difference appears for the average duration, in contrast with the workgroup-level differences evident above for the percentage of time spent in FTF interaction. The qualitative tendency towards more formal FTF interactions in Site 2 is reflected quantitatively in longer average
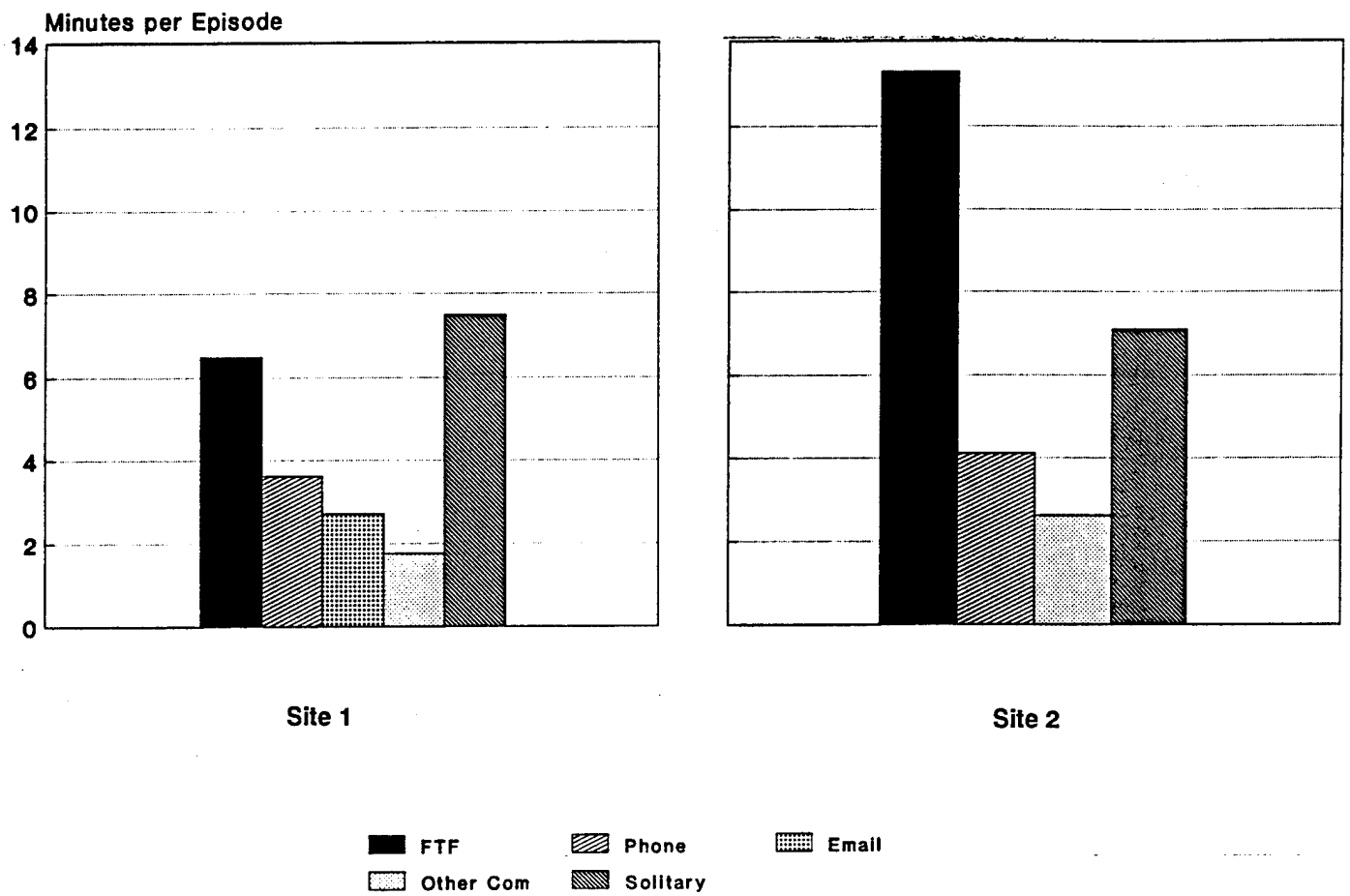
Figure 8.3   Episode Duration of Work Activities
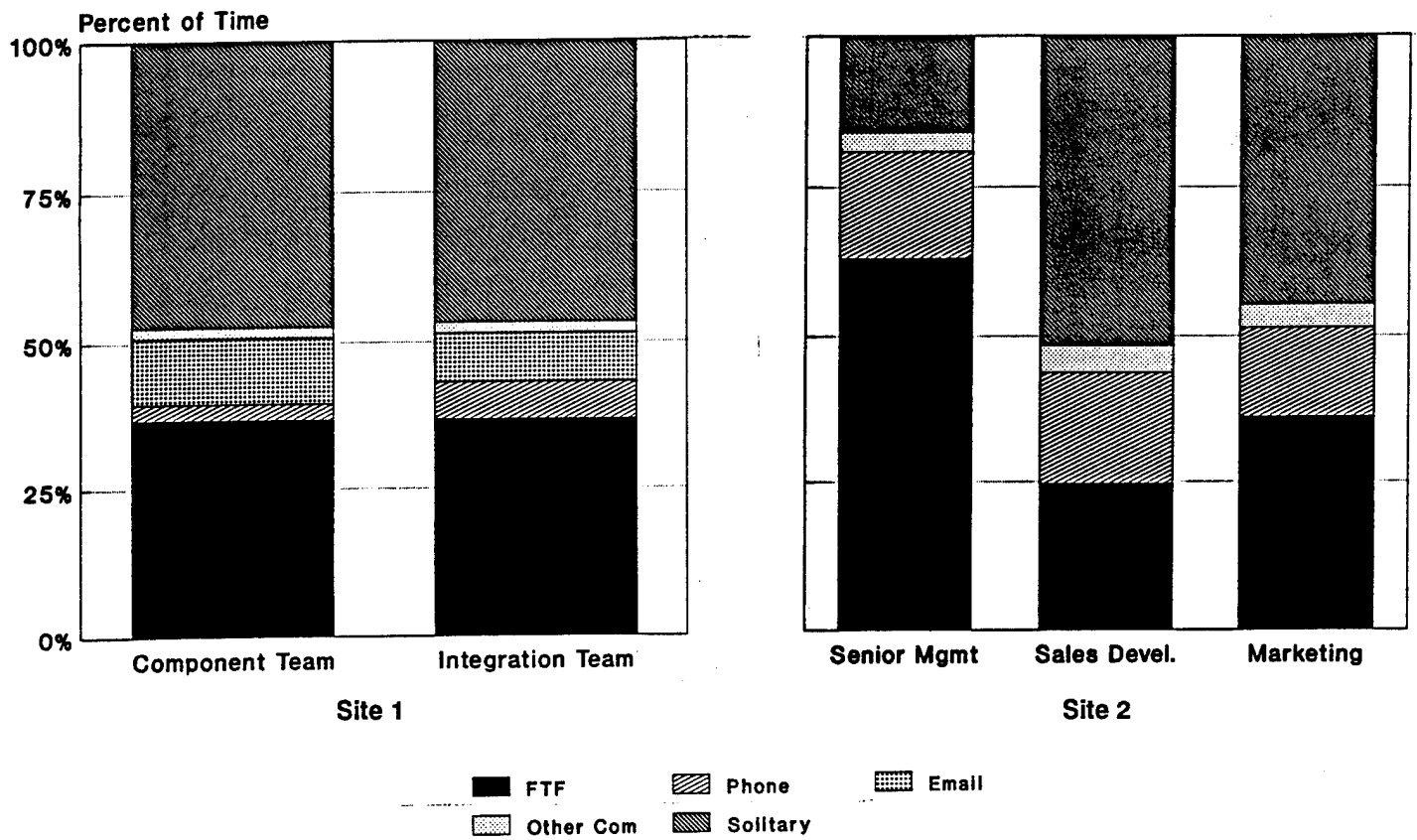
Figure 8.4   Workgroup Activities: Time Distribution

133
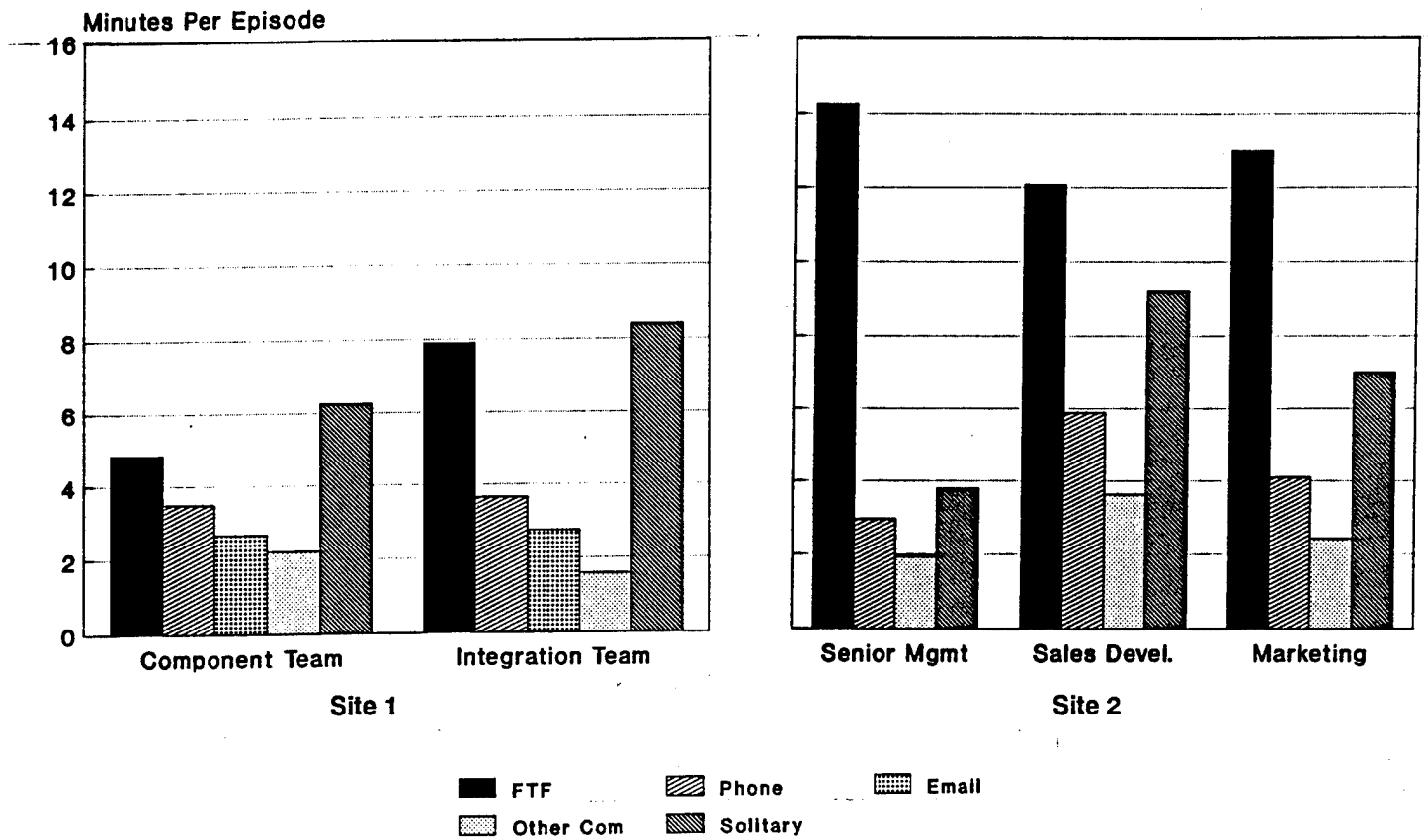
Figure 8.5   Workgroup Activities: Episode Duration

episode durations for FTF communication. As noted in Chapter 7, the very short average duration of episodes of solitary work among members of the Senior team distinguishes them from members of other workgroups in Site 2; in the present figure, their distinctiveness appears to extend further to the workgroups from Site 1 as well.

8.3 Channel Usage

The percentage of communication time spent using the various channels available in each setting is charted in Figure 8.6. The percentage of communication time spent in FTF interaction is roughly the same across the two sites, but significant differences emerge in how the non-FTF time is apportioned among channels. More time is spent using email than telephone communication in Site 1, whereas the opposite is observed in Site 2.

This pattern suggests something of a functional tradeoff between use of the telephone and email. It is interesting to note that the "appropriateness" of these two channels is deeply ingrained in both sites. Site 1 is a high-technology software and hardware engineering environment and email is considered a vital communication link. Non-users are practically unheard of and it is beyond the imagination of workers that their work could be completed without this channel. The telephone, in contrast, is viewed as convenient on occasion but intrusive and inefficient. Site 2 on the other hand, is a sales and marketing organization where conversation has always been the backbone of communicative work. In this setting telephone use is deeply ingrained and efforts to promote other channels have been foiled both by the nature of the work and tradition. Not coincidentally, support for email is practically non-existent and systems are difficult to access, and it is not surprising that only a small circle of users employ this channel with any degree of regularity and predictability. This apparent functional tradeoff between use of the telephone and email should be given increasing theoretical attention. Particularly interesting are the implications and ramifications of the tradeoff between a synchronous (telephone) and an asynchronous (email) channel.

These channel time distributions are presented for the individual workgroups in Figure 8.7. We see relatively small pattern differences between the Component and Integration workgroups in Site 1, whereas somewhat more substantial inter-group differences are apparent in Site 2. The major between-group differences evident in Site 2 concern the relative use of FTF and telephone communication. A higher percentage of communication is conducted by telephone (and less by FTF interaction) for members of the spatially distributed Sales Development group; this difference -- not at all unexpected for a spatially dispersed group -- will be sharpened below when interactions between the type and channel of communication are considered.

8.4 Breadth of Interaction

Figure 8.8 displays the breadth of interaction observed in each site as a function of communication channels. The number of distinct individuals with whom workgroup members communicated are displayed in each panel of the figure. Black bars represent all communications, whereas the variously shaded bars are for communications through particular channels. Note that the scales for the two sites are different for this figure; it is not the comparison of absolute numbers of
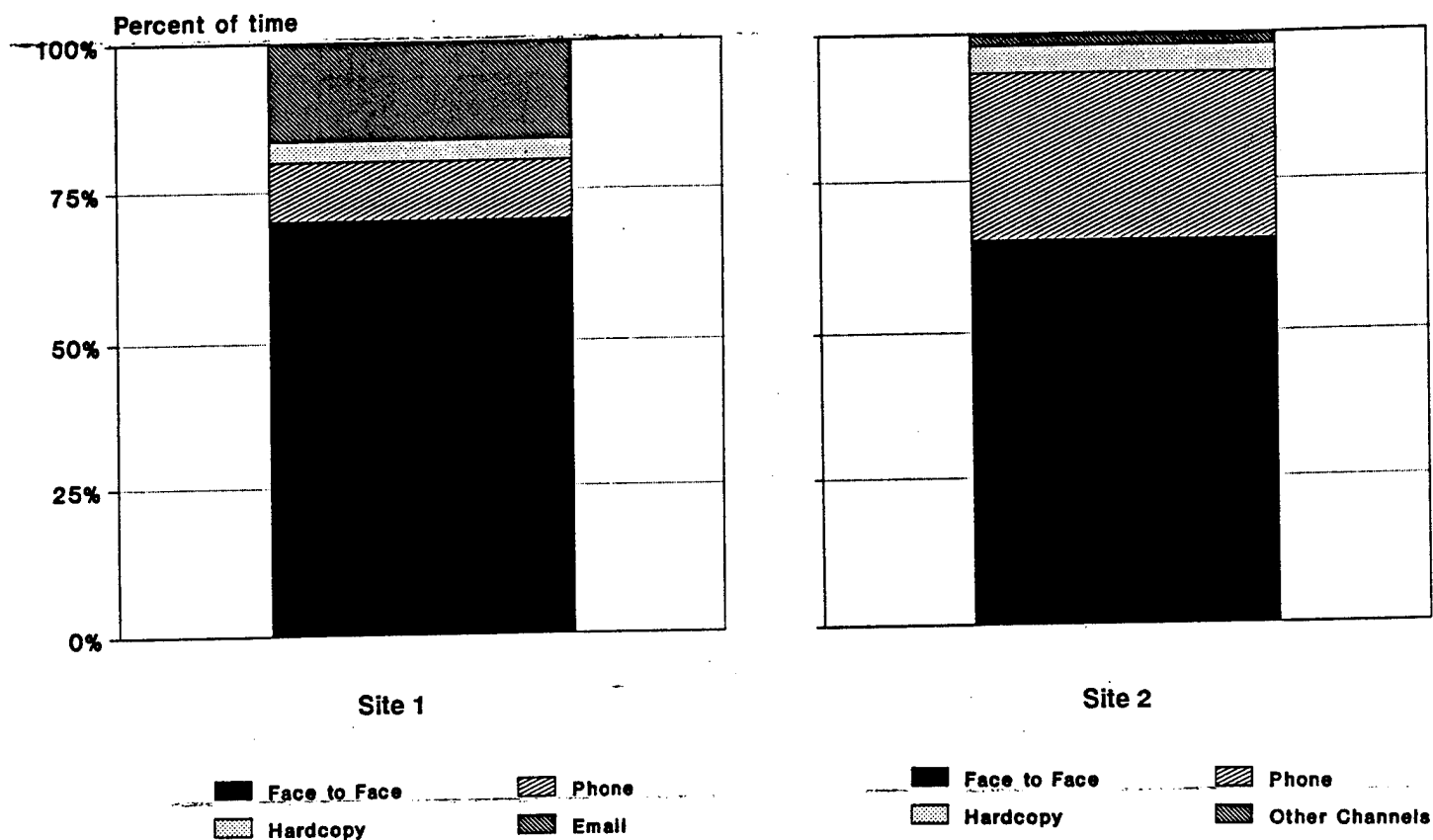
Figure 8.6   Time Distribution of Communication
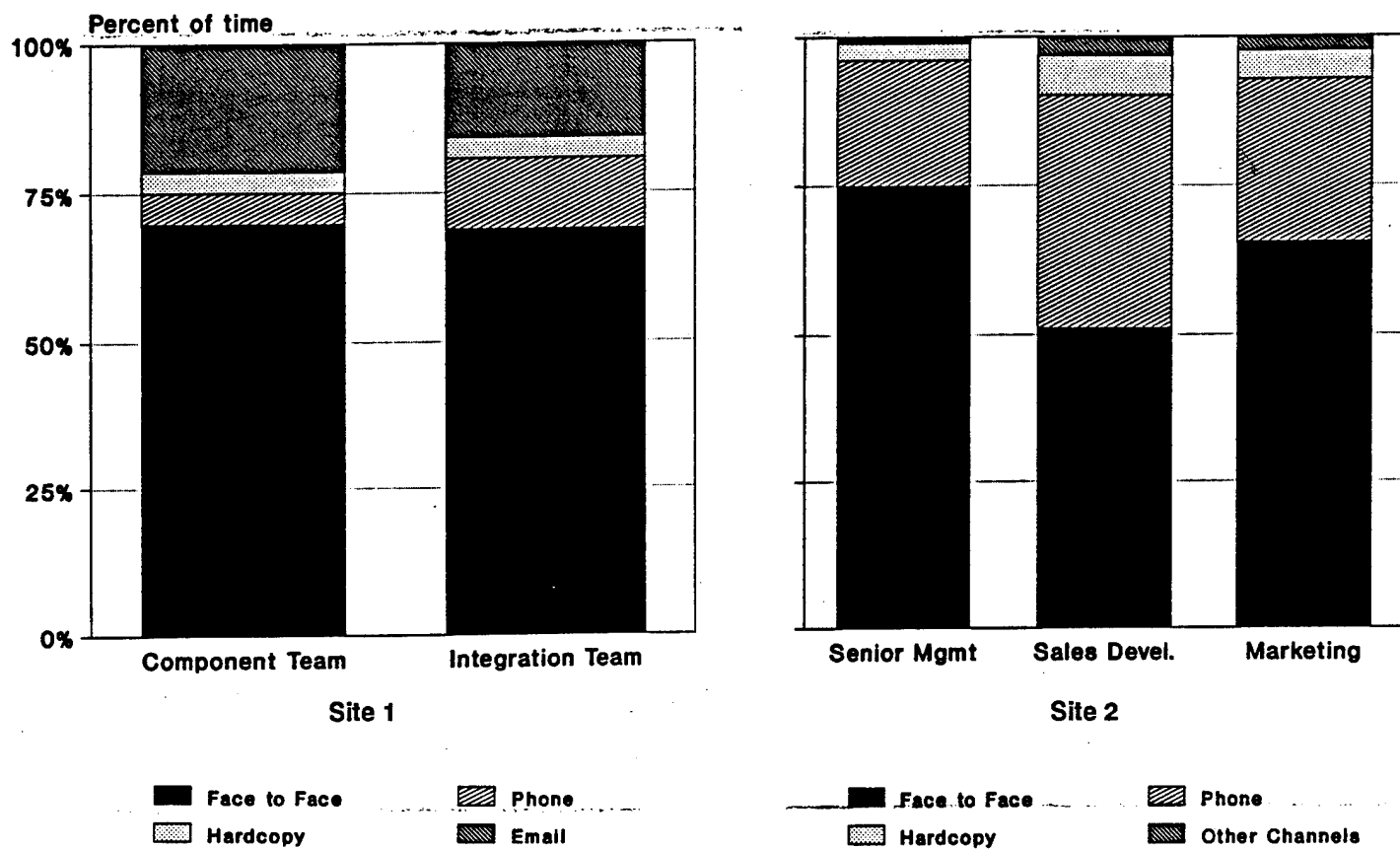
Figure 8.7   Workgroup Communication: Time Distribution

137
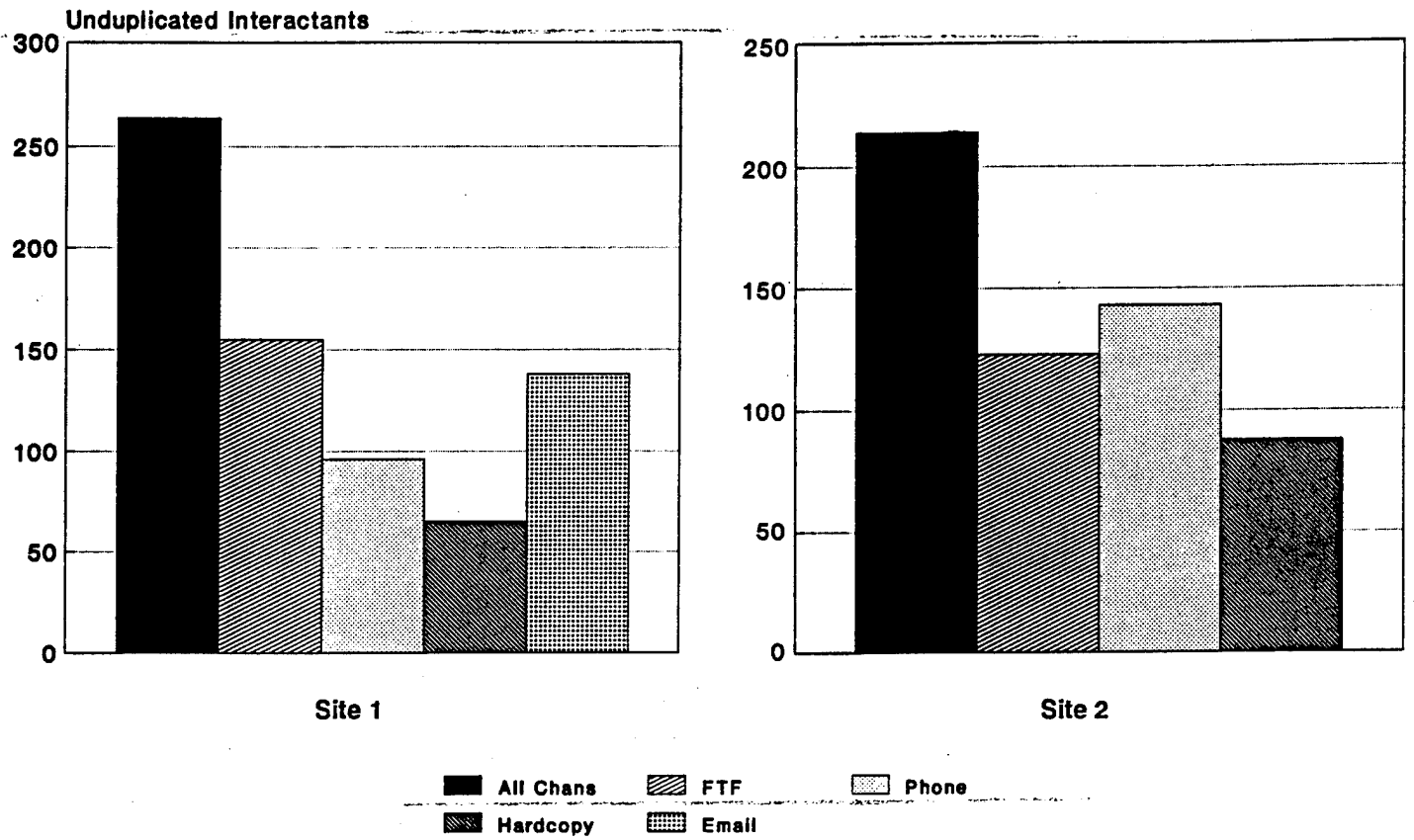
Figure 8.8   Breadth of Interaction

138

interactants (since number of shadowing days varied between the sites) that is of interest, but rather how they are relatively patterned across the channels. Also note that email is broken out separately for Site 1.

The same data are displayed in Figure 8.9 for individual workgroups within the sites. Although the absolute values (i.e., the overall height of the bars) vary by group because of different group sizes and thus total days of shadowing, the relative patterning is similar across the groups within a site.

The channel patterning in these data varies over the two sites, however. There are two primary channels (in terms of this measure of breadth of use) evident in each site: FTF and email in Site 1, and FTF and telephone in Site 2. Once again, a picture emerges in which FTF communication appears to serve a decisive communicative role within the functioning of the workgroups, complemented by another major channel. In Io Products, the second major channel is email, whereas in Parallax Systems, it is the telephone. Email and telephone again appear to be functionally overlapping and in these studies.

8.5 Organizational Communication

The figures presented in this section compare across sites the ways in which communications involving workgroup members are distributed across alternative channels and organizational roles of those with whom they interact. Figure 8.10 displays one such cross-classification of the communicative interactions for the two sites. For each of the major communicative channels used, the distribution of interactions using the channel is shown in a bar chart; the four components of each bar reflect the percentage of interactions in the given channel that involve individuals in the workgroup member's own group, own division (but not own group), company (but not own division) and not in the company.

Notice that the leftmost three bars in each site are comparable, representing communications taking place through FTF, phone and hardcopy, respectively; the rightmost bar in Site 1 represents email communication. Comparing the three leftmost bars from Site 1 with the corresponding three bars from Site 2, a strikingly similar pattern of organizational communication x channel usage can be seen across these sites. For each site, approximately half of the interactions in each channel represent "divisional" communication (i.e., outside of the immediate workgroup but within the containing division of the company). This also holds for the email-based communication in Site 1. This "divisional" level of organizational communication appears not to be differentially supported by alternative communication channels. But the role of alternative communication channels in supporting other levels of organizational communication does vary systematically. This is further illustrated in Figure 8.11, in which the same data set is broken down in a different manner.

Figure 8.11 charts the percentage of communicative interactions within each organizational level that take place through various channels. The leftmost bar ("Own Group") in each panel, for example, shows the percentage of intra-workgroup communications which take place through the various channels. Note that the topmost component of each bar has a slightly different interpretation for the two sites. In Site 1, the topmost component is email, whereas in Site 2 it is "Other" channels (including fax and email but is primarily fax); other components are identical for both sites, as indicated in the two legends.
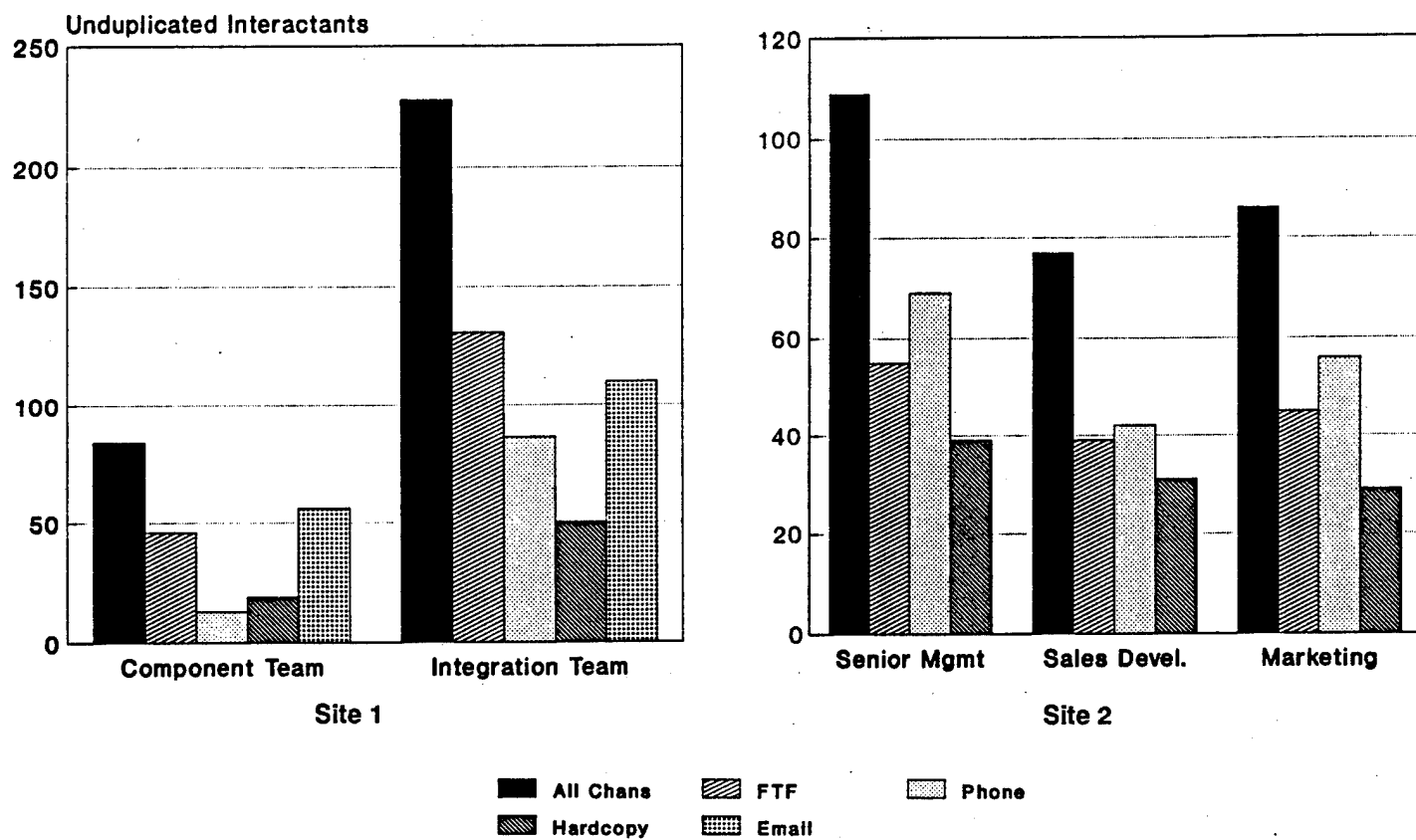
Figure 8.9   Breadth of Interaction in the Workgroups

Percent of interactions
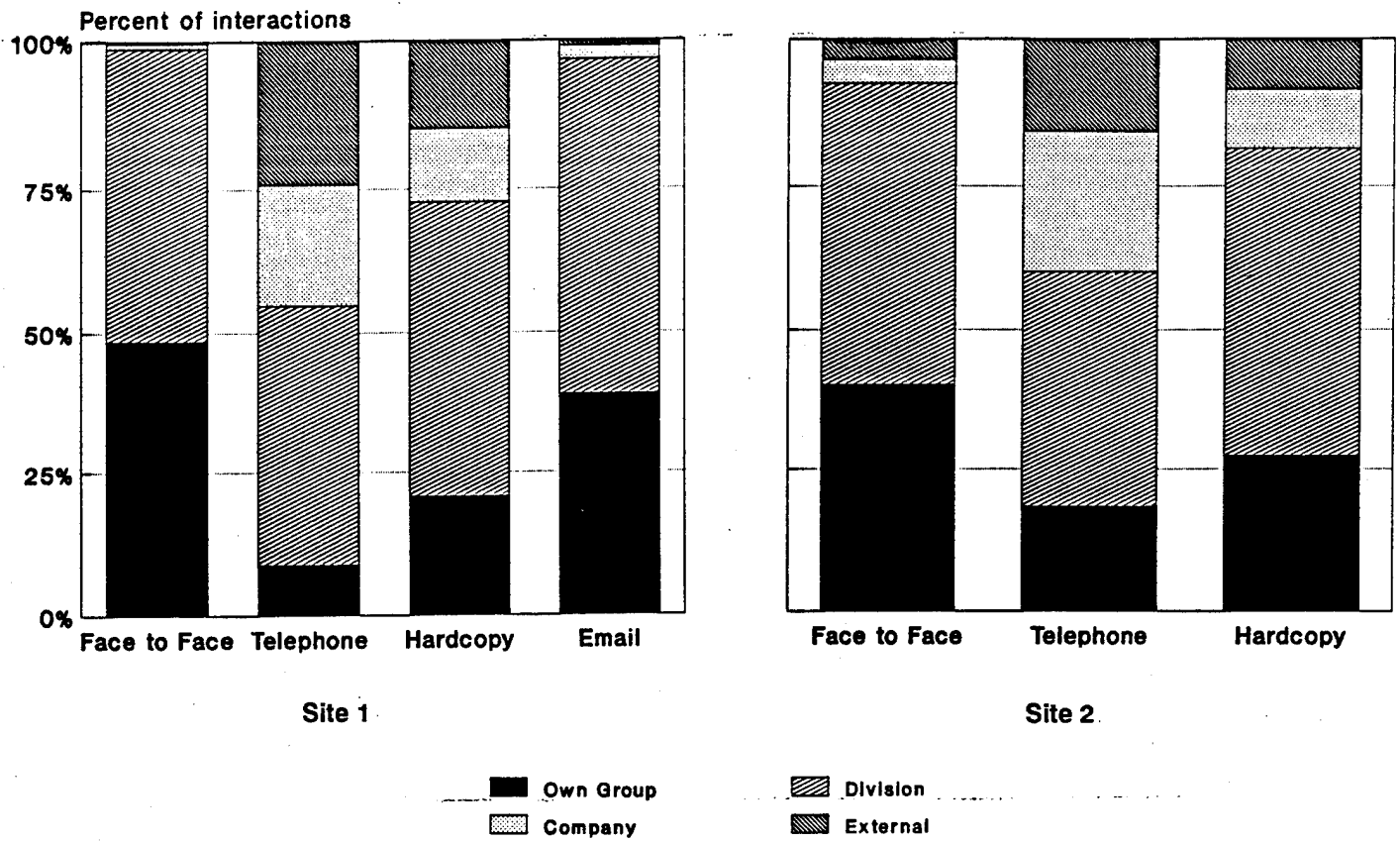
Figure 8.10   Organizational Communication by Channel

141
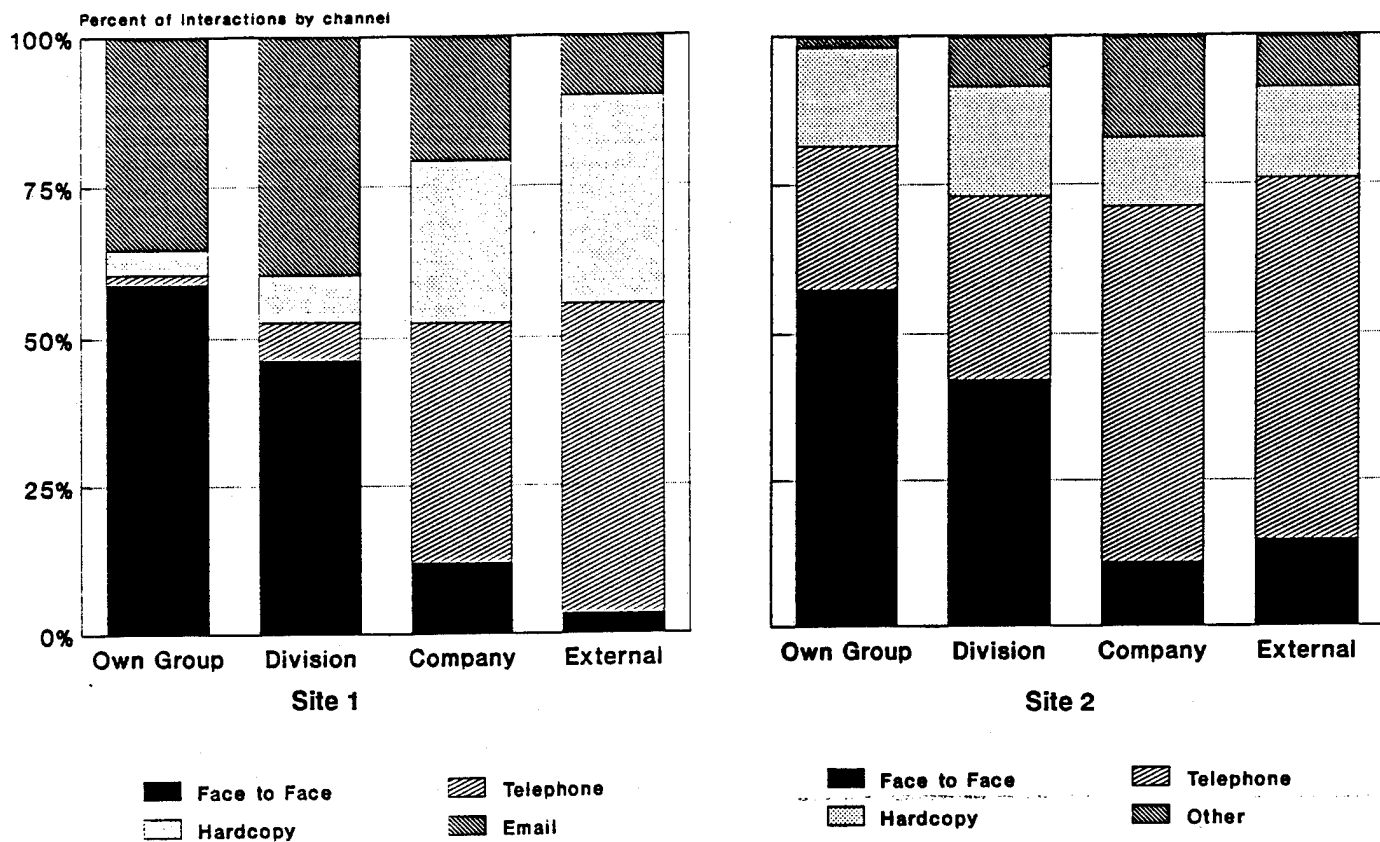
Figure 8.11 Organizational Communication by Interactant's Status

There are some important similarities and differences between the sites evident in the figure. Looking first at the bottom (black) component of the bar, FTF communication, one sees for both sites that the dominance of FTF interaction diminishes steadily as organizational distance increases from intra-group to intra-divisional to intra-company to external. Second, as FTF interaction decreases with increasing organizational distance, telephone usage increases in a complementary fashion in both sites, so that the sum of the bottom two components is roughly constant across the range of organizational contexts (this nearly constant sum for each given site can be read in the figure as the height of the line between the telephone and hardcopy components of each bar). This sum, of course, is the percentage use of *synchronous* channels (i.e., those requiring interactants to participate simultaneously: FTF and telephone). The fact that this synchronous sum is relatively constant across organizational contexts suggests that there may be relatively fixed components of organizational communication (termed here the synchronous and asynchronous components) which may be variously realized by alternative channels depending on logistical factors such as the relative accessibility of the channel (i.e., FTF and phone are alternative ways to implement synchronous communication, whereas hardcopy and email are alternative realizations of asynchronous communication).

Although each site displays a relatively constant proportion of synchronous communication across organizational contexts, that constant varies significantly between the two sites, as can be seen in the figure. Whereas approximately half of the communicative interactions in Io Products (Site 1) are synchronous (regardless of the organizational context), about three-fourths of the communicative interactions at Parallax Systems (Site 2) are synchronous (again, regardless of the organizational context).

The next three figures compare the two sites in terms of workgroup-specific patterns of channel usage; each figure displays the five studied workgroups' patterns in a different organizational context: intra-group (Figure 8.12), intra-division (Figure 8.13) and intra-company (Figure 8.14). In these figures, each of five bar charts depict one of the workgroup's channel usage pattern in terms of the percentage of communicative interactions accomplished by FTF, phone, hardcopy or other channels.

Figure 8.12 displays channel usage patterns for intra-group communication. The two workgroups studied in Site 1 appear to use similar patterns, relying principally on FTF and email for their peer-to-peer communications, one primary channel for synchronous and one primary channel for asynchronous communication needs. The three workgroups in Site 2, however, exhibit different patterns of intra-group communication. The Sales Development group (middle bar) relies heavily on use of the telephone for intra-group communication, whereas the other groups rely primarily on face-to-face and hardcopy for intra-group communication. The importance of the telephone to the Sales Development group, of course, is closely related to the extreme spatial dispersion of the group (FTF is usually impractical for them). Of particular interest here is the relatively constant proportion of synchronous communication for each of the workgroups in a given site (despite overall site differences in the synchronous proportion), even though there may be wide variations in how the synchronous (and asynchronous) communications are realized (e.g., the sharp difference between the Sales Development and other groups' use of FTF vs. telephone).
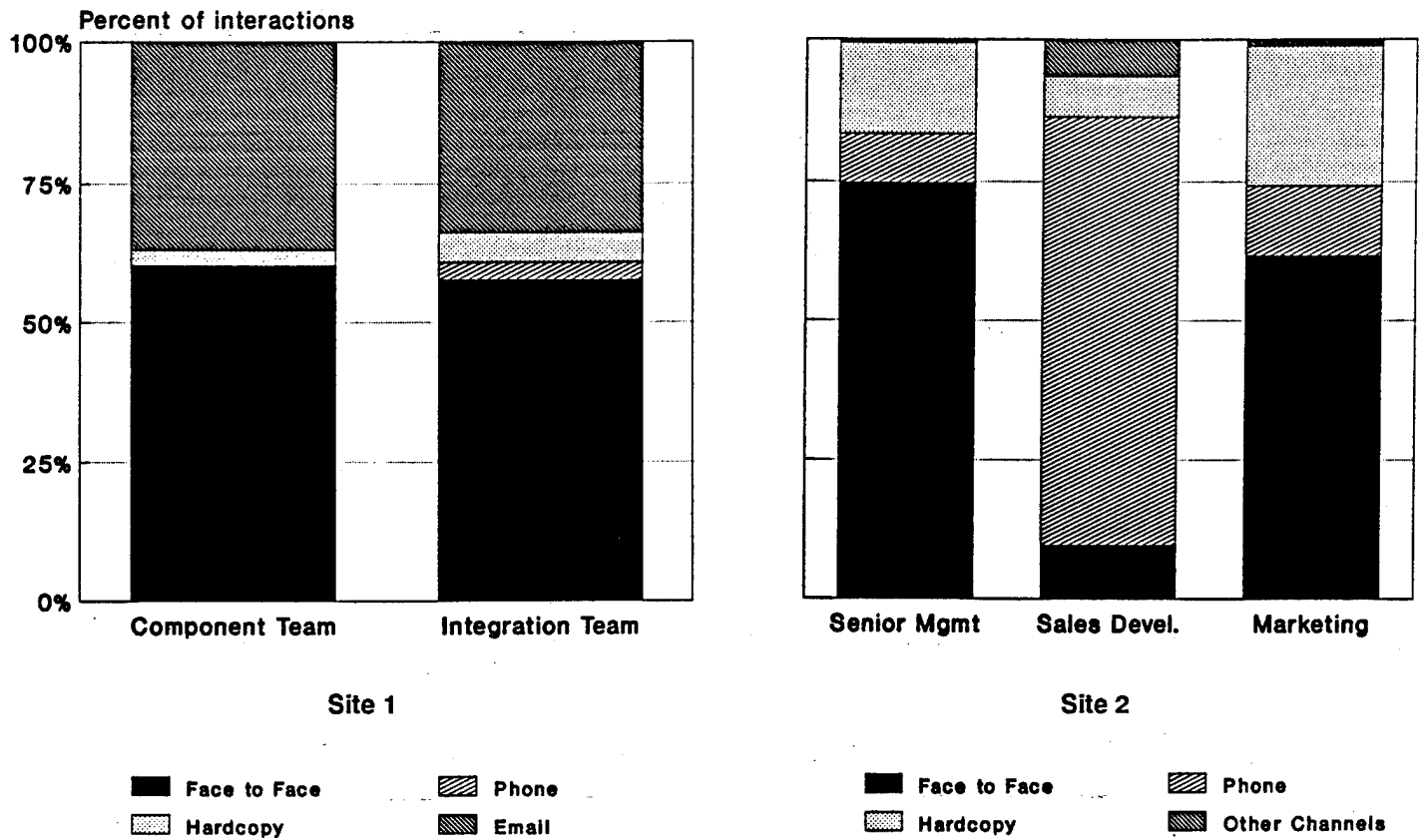
Figure 8.12   Channel Usage in Organizational Communication: Intra-Group
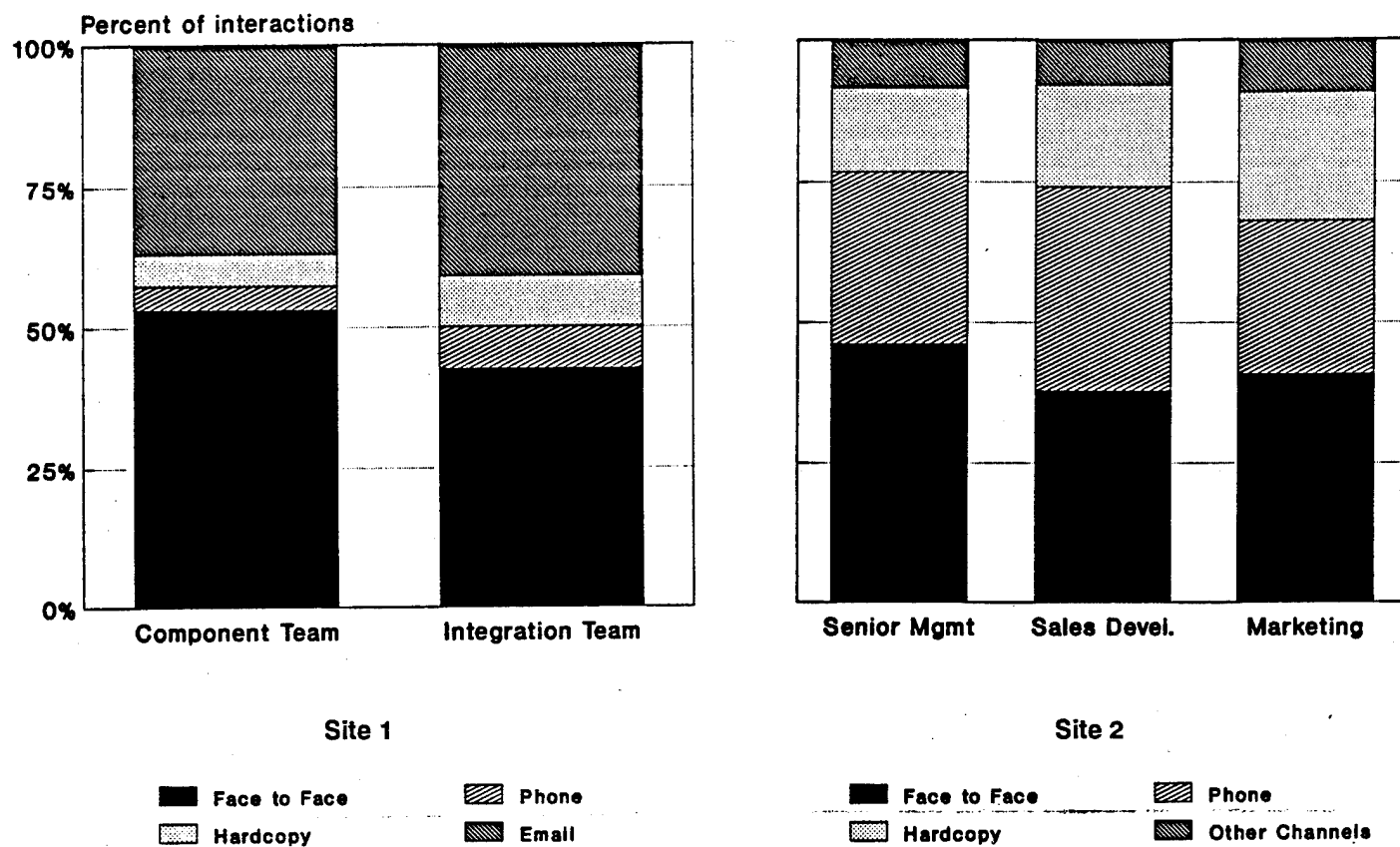
Figure 8.13   Channel Usage in Organizational Communication: Intra-Division
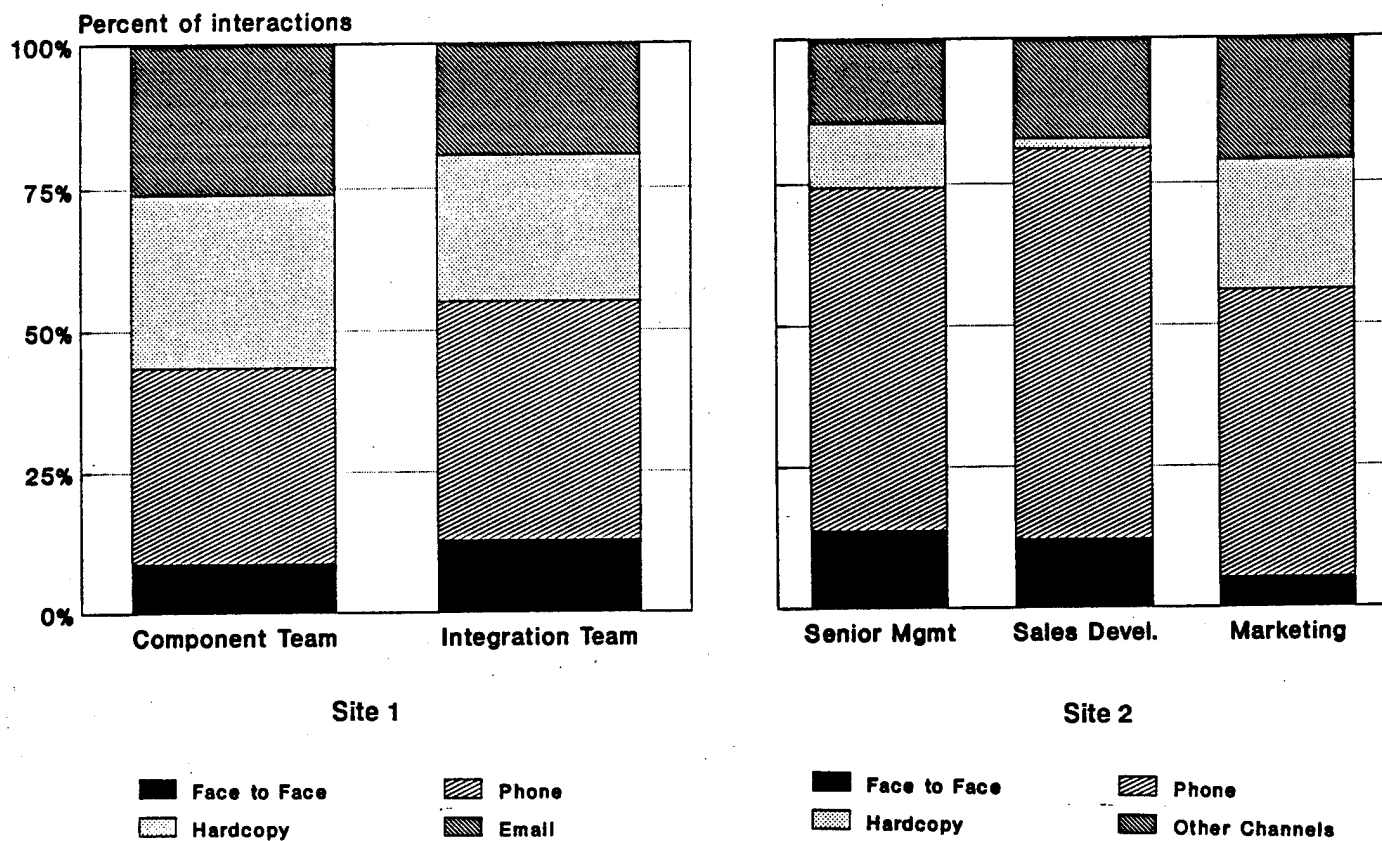
Figure 8.14   Channel Usage in Organizational Communication: Intra-Company

As we move to progressively more remote organizational contexts in Figures 8.13 (intra-division) and 8.14 (intra-company), the basic patterns of channel utilization among the groups persist, but the channel usage patterns realizing those patterns vary. Looking at intra-divisional communication (Figure 8.13), for example, we see that the various workgroups within a site exhibit similar profiles; the Sales Development group, in particular, no longer stands out in its use of telephone vs. FTF channels -- indeed, its members are no more dispersed with respect to their divisional colleagues who are outside of their immediate workgroups than are members of other groups with respect to their divisional peers. In fact, it is at this divisional level of organizational context that communication patterns for the five studied workgroups are most similar. As we move towards intra-company communication (Figure 8.14), FTF becomes a less frequent and telephone a more frequent realization of synchronous communication; hardcopy becomes a more frequent and other channels a less frequent realization of asynchronous communication.

8.6 Communicative Chains and Channel Switching

The ubiquity of communicative chains and channel switching were findings of considerable interest in both Chapter 5 (Site 1) and Chapter 7 (Site 2). Figures 8.15 and 8.16 merely recap and display parallel sets of findings from the two sites. Figure 8.15 exhibits the distribution of lengths of task-specific, interactant-specific communicative chains observed within a single day in each of the sites. Although the scales differ for the two sites, the overall shape of the distribution is similar. Figure 8.16 is a composite graph which superimposes the channel switching curves from the two studies. Although channel switching occurs with higher relative frequency in Site 2, the shapes of the two curves appear to be quite similar.

8.7 Individual Multitasking

Another important finding in each study was the phenomenon of individual multitasking. Figure 8.17 shows a scattergram of individuals' mean (i.e., running average) stack size against their average number of tasks per day. Each point is an individual, plotted with symbols representing their workgroup. In looking at these data, superimposed from the corresponding site-specific plots considered in Chapters 5 and 7, a number of points should be made. First, the range of individual variation is profound and likely reflect observed differences in both job content and work style. Second, although the workgroups overlap considerably in these plots of individuals, the top managers from both sites seem to cluster into a unique set; members of the Senior Management group from Site 2, plotted with open squares, and the two managers of the Integration group from Site 1 plotted with "+"s near the top middle of the figure, seem to cluster qualitatively in the figure. Managerial activities are both qualitatively and quantitatively distinct from the professional and technical activities. Third, although there is clearly a positive correlation between the number of tasks per day and the mean stack size (i.e., average number of tasks in one's "stack"), the measures are distinct; the ways in which individuals manage their multiple tasks (for a given number of tasks per day) has considerable influence over average stack size.
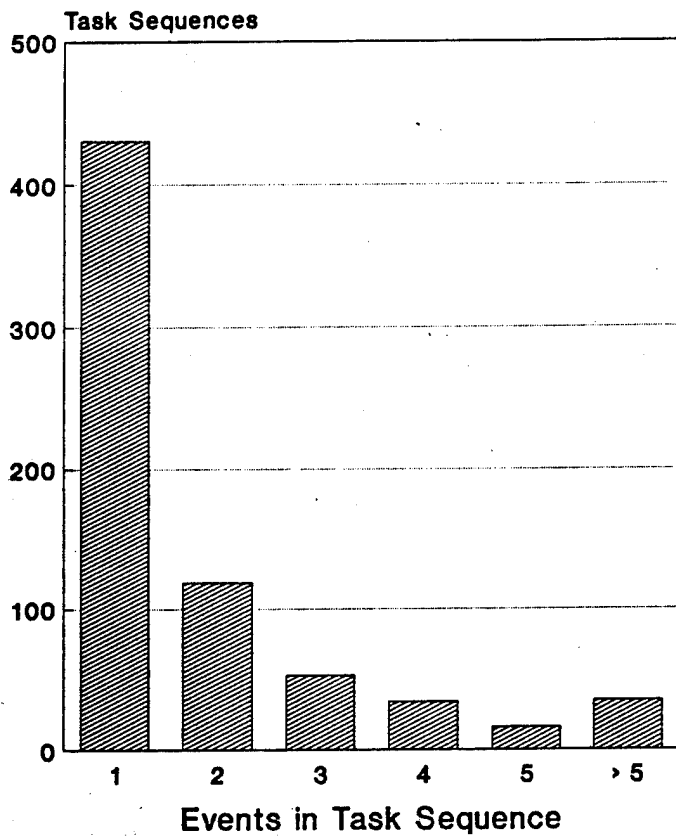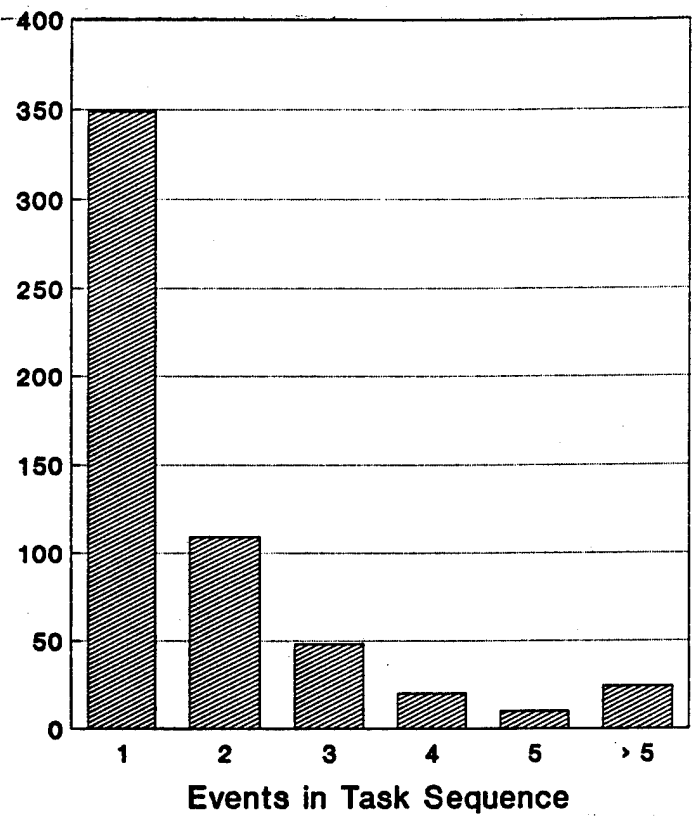
Figure 8.15   Communicative Chains
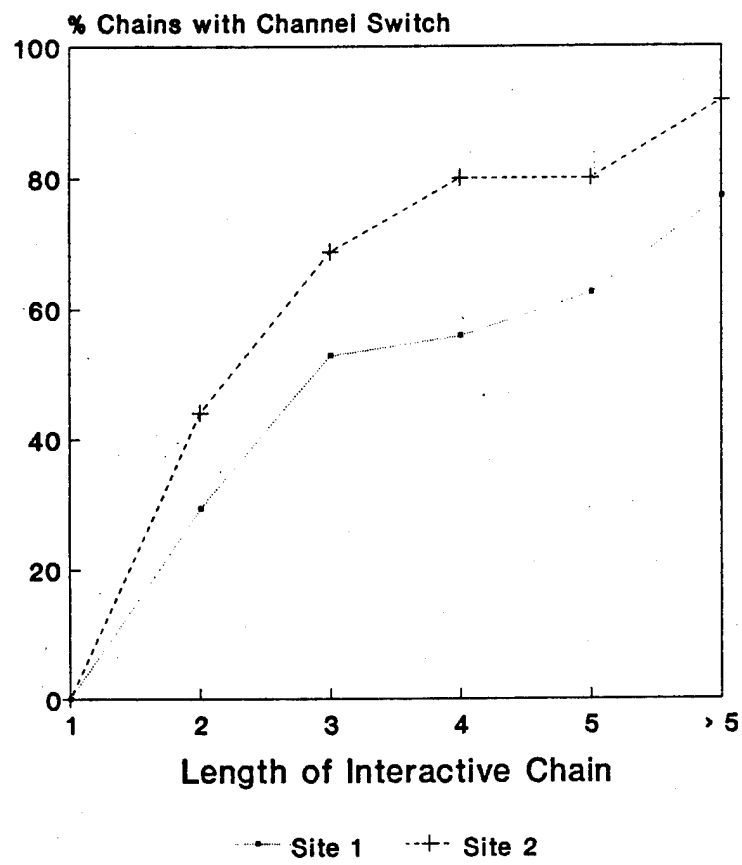
Figure 8.16   Channel Switching
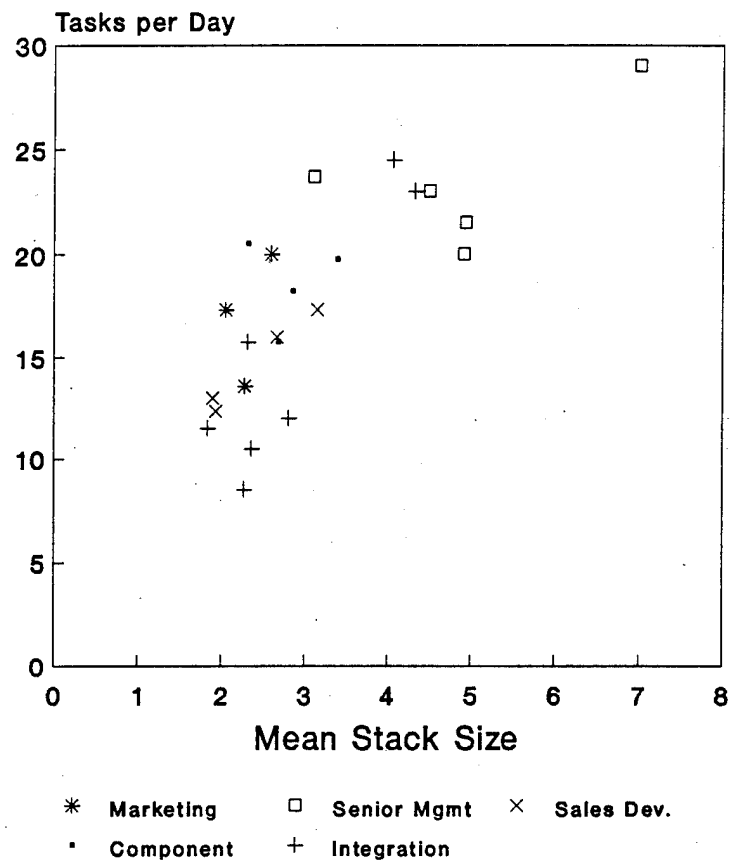
Figure 8.17   Individual Tasks/Day X Stack Size

8.8 Self-Management Activities

The importance of non-task-specific or self-management activities (e.g., going through one's inbox, maintaining one's schedule, filing papers off of one's desk) was evident in both sites. Figure 8.18 displays the percentage of the work day spent in such activities for each of the studied workgroups. The groups spend from about 10% to 20% of their time in non-specific activities. As might be anticipated from the previous section, members of the Senior Management team spend by far the most time on self-management activities.

Many of the contrasts described in this chapter will emerge in discussions of project implications and applications in chapters 10 and 11. In the next chapter some additional results from the research conducted in Site 2 will be presented.
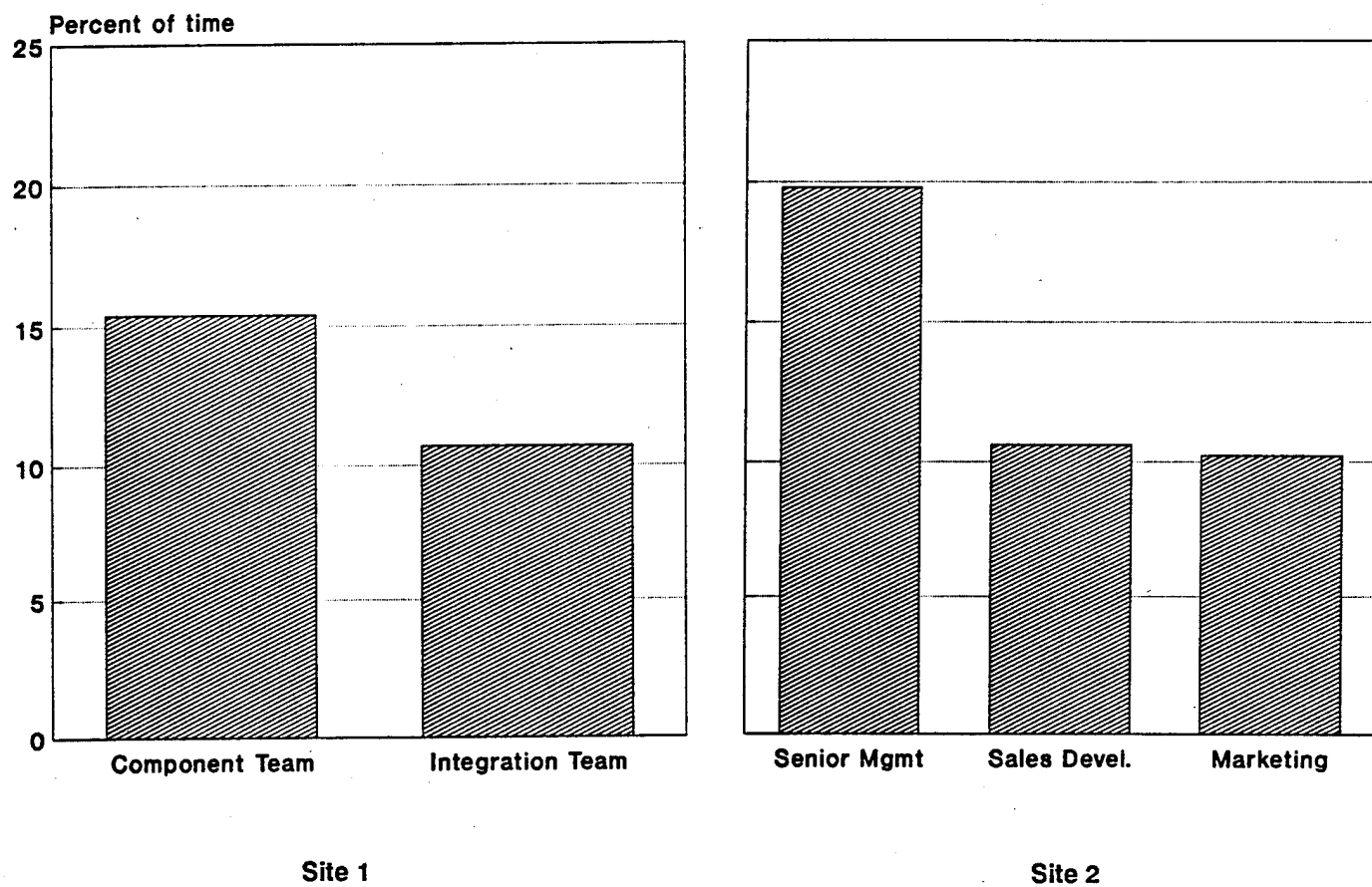
Figure 8.18   Non-Specific Activity: Time Distribution

9.0 FURTHER RESULTS FROM THE SHADOWING STUDY IN SITE 2

This chapter presents some additional analyses carried out on data from the shadowing study in Site 2. The results of the primary analyses -- i.e., those comparable with Site 1 -- were presented in Chapter 7. But because of the methodological refinements made in Site 2, additional types of data are available and further analyses are possible in Site 2 that were not collected or could not be performed in Site 1.

9.1 Distribution of Activity Among Workgroup Members

The observers met after all of the data had been collected to look at the range and overlap of tasks observed across the shadowing sessions. These were identified and sorted by the observers into sets of recurrent *key tasks* related to major workgroup objectives. These key tasks appeared with a high degree of reularity and indicated tasks of special significance in terms of time devoted to the task. An example of one key task for the Senior Management group involved a strategic acquisition of another company. From the observations of the Senior Management, Sales Development and Marketing groups, eleven, eight and thirteen key tasks were identified, respectively.

Figure 9.1 exhibits the percentage of time members of the three workgroups were observed to be engaged in these key tasks. Overall, individuals spent about one-third (32.6%) of their time engaged in key tasks, although the data plotted in the figure exhibits sharp differences among the three workgroups. As noted in the figure, these data are based on simple episodes only[1]. The Marketing group spends substantially more of its time on its key group tasks than do either of the dispersed workgroups on their key tasks. The Marketing group spends over half of its time (53.8%) on key group tasks, whereas the Senior Management and Sales Development workgroups spend, respectively, only 13.3% and 22.5% of their time on their key tasks.

This quantitative difference is consistent with the observers' sense that the Marketing group went about its key tasks in a manner that was qualitatively distinct from that of the other workgroups. Members of the smaller, more collocated and less dispersed-by-travel Marketing group found it easier to communicate and collaborate about key tasks on which they were working; they tended to spend more time working on parallel aspects of the same tasks.

To see if this might also be reflected in the quantitative data, an analysis was conducted of the percentage of each workgroup that was observed to be working (to some extent) on each of the key group tasks. If two out of three shadowed members of a workgroup were at some point observed to be working on a given key task, a weight of 2/3 was entered for that key task for the workgroup; if only one out of five shadowed members of a workgroup was at some point observed to be working on a key task, a weight of 1/5 was entered for the workgroup on that key task. These weights were averaged over all key tasks for each workgroup, and an average percentage of shadowed workgroup members active in key tasks was calculated for

---

[1] Compound episodes often intermix key tasks with other tasks in a way that makes it difficult to allocate time directly to key tasks. For this reason, we felt the best estimates are based on simple episodes. Workgroup differences, however, are quite robust across a number of ways we handled the compound episode data.

% of time
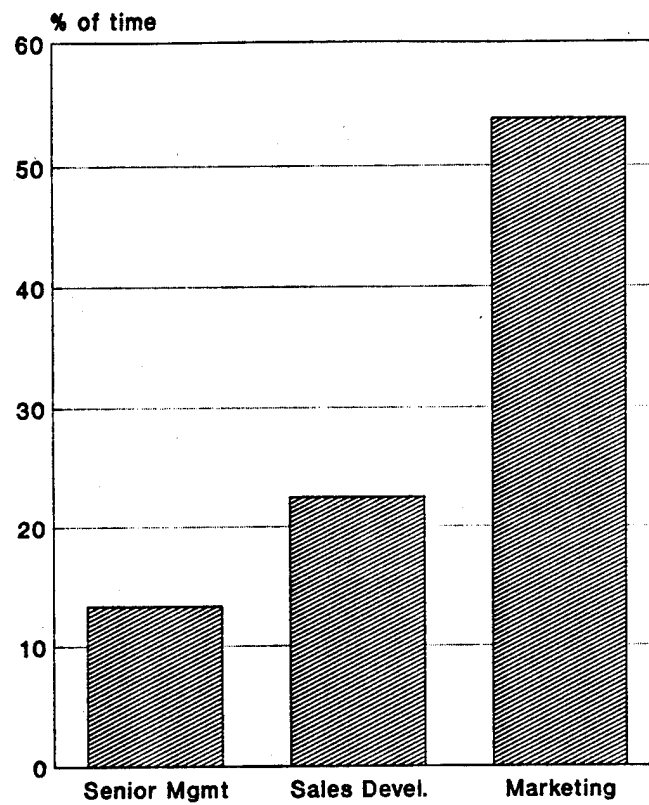
(Simple episodes: N=1249)

Figure 9.1 Key Task Activity

% of workgroup collaborating
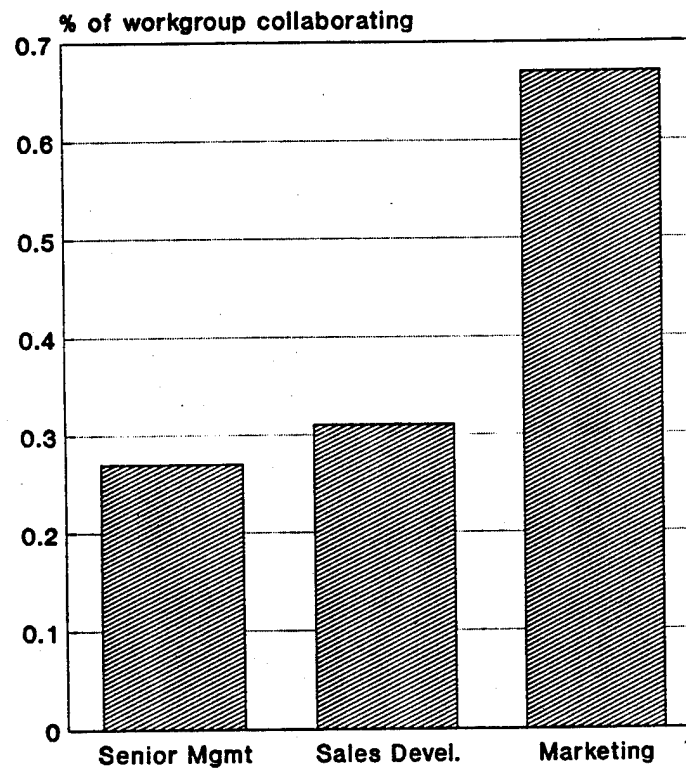
(Simple episodes: N=1249)

Figure 9.2 Workgroup Collaboration on Key Tasks

154

each workgroup. The results of this analysis can be seen in Figure 9.2. There is a much higher average percentage of the workgroup active on a given key task (.67) for the Marketing group compared to the dispersed groups (.27 and .31). Crude as these measures may seem, they do seem to capture some major qualitative differences observed in the workstyles of the three groups.

9.2 Another measure of multitasking

Multitasking in Site 2, using the "Method A" operational measure of "stack depth", was analyzed above in Section 7.8. In this section, a second operational measure of an individual's momentary "stack depth", termed *Method B*, is used to analyze multitasking. Recall that the operational definition of Method A identifies a given task as being on an individual's "stack" whenever the individual (1) is not working on it at the moment; (2) has worked on it previously in the day; and (3) works on it again later the same day. Method A has the advantage of being based entirely on observed activities, but the drawback of measuring only that fraction of an individual's task stack visible within the frame of a single day; excluded from the Method A measure are tasks that start one day and are returned to a different day, for example.

Method B defines any task to be on an individual's stack at a given point in time if the individual (1) is not working on it at the moment; (2) has worked on it previously during the day; and (3) works on it again later the same day or there is definite evidence that the individual will work on the task again at some point in the future. Parts (1), (2) and the first half of (3) are identical to Method A; the last part of criterion (3) broadens the definition, and is based on judgments made by the observer as to whether the shadowee will return to the task at some time in the future. If the "Next Communication" field[2] of the observation sheet specify future activity by the shadowee on the task, then criterion (3) is satisfied. The methodological tradeoff here between Methods A and B is that although Method B encompasses a broader section of an individual's "task stack" (but still not all of it, since tasks last engaged before the observation day may not be counted), it is based less on directly observable events and more on observers' judgments or ratings. As we shall soon see, however, the two methods of measuring task stacks yield similar patterns among individuals and workgroups, even though Method B provides larger overall estimates of the stack sizes. The principal results regarding multitasking are thus not sensitive to the particular measurement technique.

Figure 9.3 displays workgroup level averages of the size of individuals' task stacks using Method B. These data should be compared with those plotted in Figure 7.33 using Method A. Note that the ordinate scales of the two figures differ, reflecting the consistently larger estimates of Method B. Nevertheless, the main features of the results are the same across the two figures. Sharp differences can be seen between the Senior Management Team and the other two groups. Tasks are substantially more "stacked up" for individual members of the Senior Management workgroup.

The corresponding data for individual participants are displayed in Figures 9.4, which can be compared with the Method A results seen above in Figure 7.34. Just as we saw with the Method A measures, workgroup differences in multitasking are readily apparent at the individual level. Using Method B measures, there is no

---

[2]   See Chapter 3 for an explanation of these categories

155

Task Stack

Top: Running Avg   Top: Peak Value
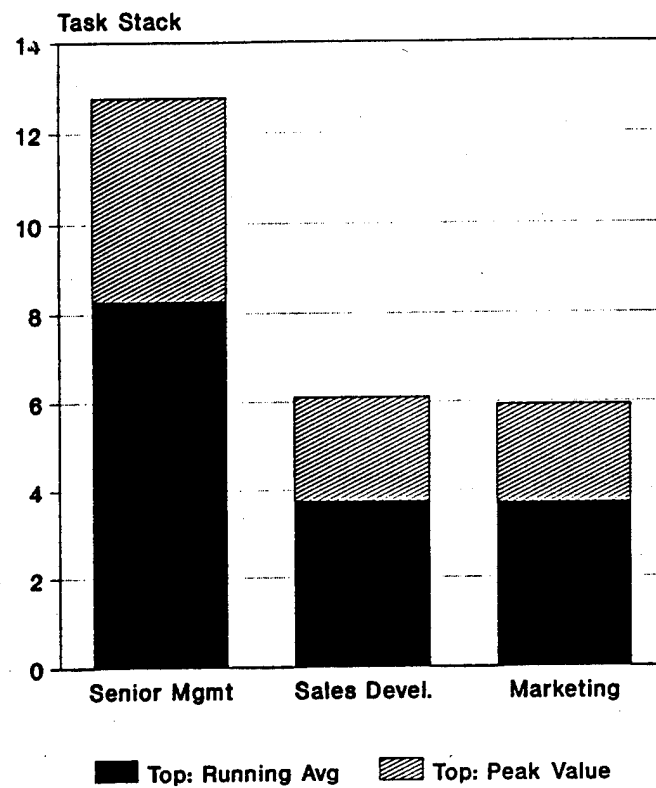
Note: Averaged per Day (Method B)

Figure 9.3   Workgroup Levels of Multitasking (Method B)

 # Tasks (Method B)

Top: Avg.   Top: Peak
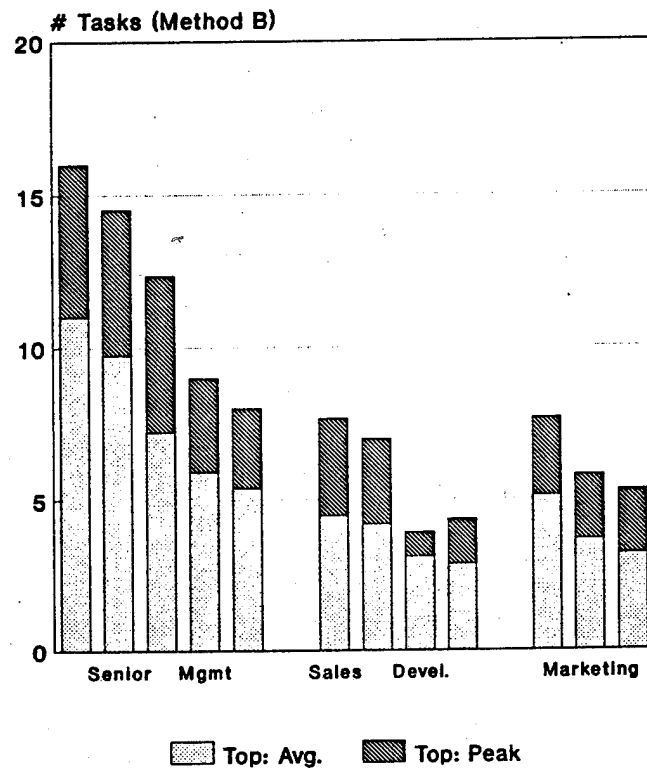
Figure 9.4   Individual Task Stacks (Method B)

156

overlap between the Senior and other teams among individual peak or running average stack sizes. As seen in the corresponding Method A data, these data suggest that some immediate workgroup environments shape the multitasking behavior of their individual members. The implications of this possibility will be considered below in Chapters 10 and 11; the important point here is that the results hold using distinct operational measures.

Figure 9.5 cross-plots individuals' average numbers of tasks per day against their average Method B stack size. The corresponding scattergram for the Method A data is shown above in Figure 7.35. Each point plotted is the average mean value over an individual's days of being shadowed. Members of the three workgroups are plotted with distinct symbols. The same general patterns are evident in both figures. First, the Senior Management Team is again quite distinct from the other workgroups. Second, the general shape of the scattergrams reflects an anticipated positive correlation between the number of tasks per day and the average stack size for the day. Third, even though there is a positive correlation between the measures, they measure different things. In either figure, a wide range of average task sizes are associated with a given number of tasks/day. The ways in which individuals sequence and manage a given set of tasks (i.e., their multitasking behavior) influences the size of their task stack.

9.3 Compounding of Time and Activity

We have so far seen many indications of the extent to which multiple activities and interactions with numerous individuals are intertwined and "stacked up" over the course of a workday. Viewed against the temporal panorama of the workday as a whole, the individual workgroup member is enmeshed in and moves through a dynamic flux of people and activities.

But the richness of the temporal fabric of a workday cannot be fully appreciated by looking only at the compounding and intertwining of activities at the level of the day taken as a whole. Our analyses of individual multitasking, in which multiple ongoing tasks are in a state of suspension within the individual's "activity stack", suggests that there is a moment-by-moment richness and complexity in the fine structure of time and activity that constrains the individual in an ongoing way. In this section, we will look for some other indicators of this richness in the ongoing mix of activity.

Recall the basic distinction between simple and compound episodes. To a first approximation (which necessarily entails some simplification), we can look at distributions and features of these simple and compound episodes to get some preliminary indicators of the richness of ongoing activity. Compound episodes, we recall from Chapter 3, are comprised of multiple task-events, usually compounded by containing threads of multiple activities, but may also be compounded by use of multiple communication channels serving a given task and other factors as well.

Overall, 27% (461 of 1710) of the observed episodes were compound, but comprise 47.1% of the observed time (105.68 of 224.22 hours). Figure 9.6 displays the incidence of these compound episodes for each of the three workgroups. A pair of bars is displayed for each workgroup. The hatched bars exhibit the percentage of all episodes which are compound, and the dotted bars show the percentage of time which these compound episodes comprise. The three groups each exhibit the same approximate percentage of compound episodes, but somewhat different percentages

Tasks per Day

Mean Stack Size

• Marketing   + Senior Mgmt   * Sales Devel.
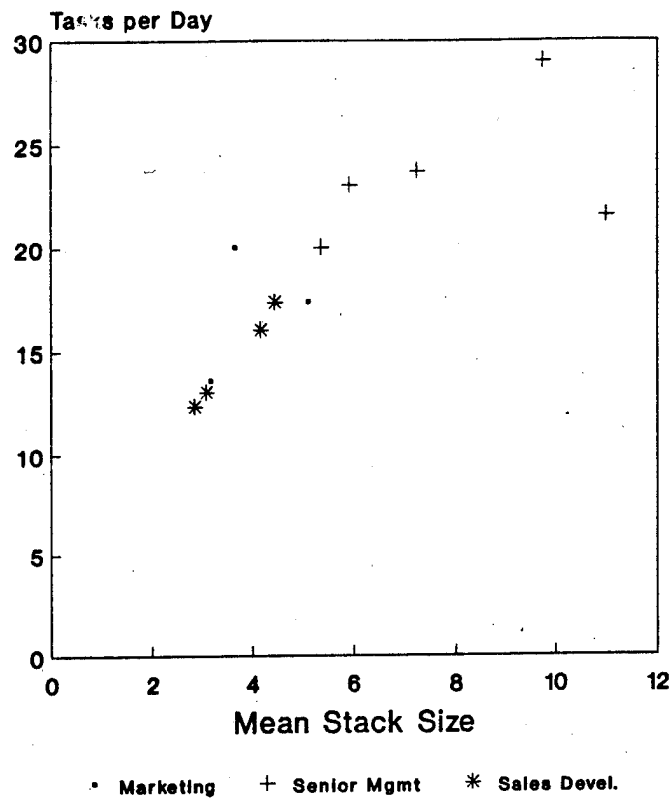
Running average (Method B)

Figure 9.5   Tasks/Day x Stack Size (Method B)

% in Compound Episodes

Senior Mgmt   Sales Devel.   Marketing

▨ # Episodes   ▦ Total Time
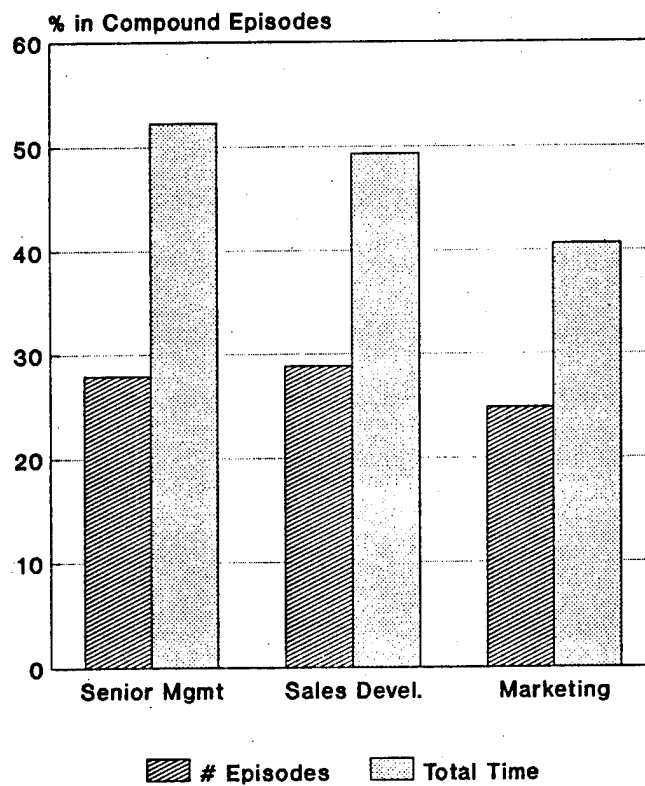
Figure 9.6   Simple vs. Compound Episodes

of their work time in compound episodes. Both the Senior Management and Sales Development groups have about 50% of their time taken up by compound episodes, compared to about 40% of the time for the Marketing workgroup.

The source of the equivalence of the percentage of compound episodes, on one hand, and the difference in percentage of compound time, on the other hand, can be seen in Figure 9.7 which shows the average durations of simple and compound episodes for the three workgroups. The three workgroups have about equal durations for simple episodes, which are much shorter than the corresponding average durations for their compound episodes. As suggested by the previous figure, the mean duration for compound episodes is markedly shorter for the Marketing group than for the other two groups.

To look more closely at the type of compounding going on in these episodes, examine Figure 9.8, which displays several dimensions of compounding within the compound episodes of the workgroups. For each workgroup, a cluster of three bars is shown in the figure. The leftmost bar in each cluster displays the mean number of task-events per compound episode; the middle bar shows the mean number of communicative task-events per compound episode; and the rightmost bar in each cluster exhibits the mean number of discrete tasks per compound episode.

Although the three workgroups have roughly the same percentage of compound episodes (as a percentage of all episodes), this figure shows that the groups' compound episodes differ qualitatively. The Sales Development and Marketing workgroups appear quite similar in terms of these data, in sharp contrast with the Senior Management Team. The Senior Management workgroup has a richer compounding within its compound episodes: more task-events, more communicative events, and more tasks per compound episode than the other workgroups. The "fabric of ongoing time" for members of the Senior Management Team is much richer and more highly intertwined than that of the other groups, a result quite consistent with their previously noted higher rates of multitasking, tasks per day, interactants per day, and so forth.

As a final illustration of the relatively rich, complex fabric which characterizes the microstructure of the Senior Management Team's activity, consider the data displayed in Figure 9.9. Plotted for each workgroup is a time distribution for all episodes (simple and compound). Episodes are sorted according to whether they are comprised of all communicative task-events (bottom portion of each bar), of no communicative task-events, or a mixture of communicative and non-communicative task-events (top portion of each bar). The Sales Development and Marketing groups appear roughly equivalent, but markedly distinct from the Senior Management workgroup. That the Senior Team has substantially less time spent in episodes with all non-communicative events should come as little surprise, given the previous results showing how much less time they spend in solitary activities.

Of particular interest in this section is the topmost portion of each bar, which represents (necessarily compound) episodes comprised of a mixture of communicative and non-communicative task-events. The Senior Management workgroup spends about 30% of its time in such episodes, nearly three times the percentage spent by the other groups. Since we saw above that the Senior Management workgroup spends about the same percentage of its time in compound episodes in general as the Sales Development group, the difference here clearly reflects more time spent in episodes specifically compounded by both communicative and non-communicative activities.
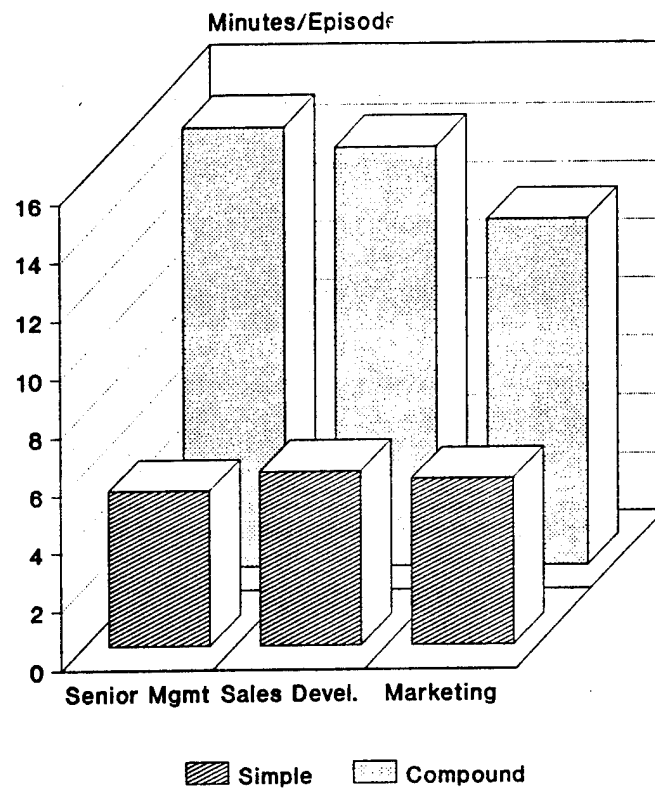
Figure 9.7   Durations of Simple and Compound Episodes
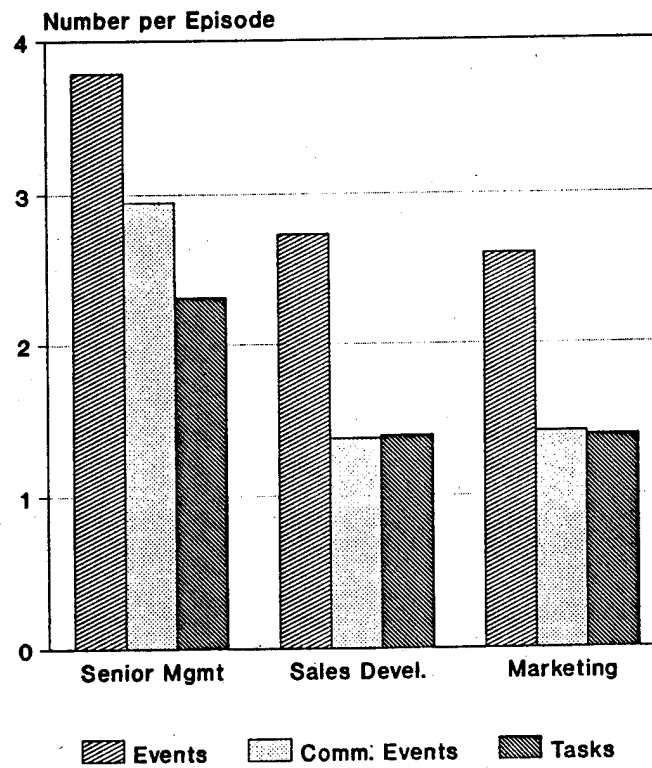
Figure 9.8   Features of Compound Episodes
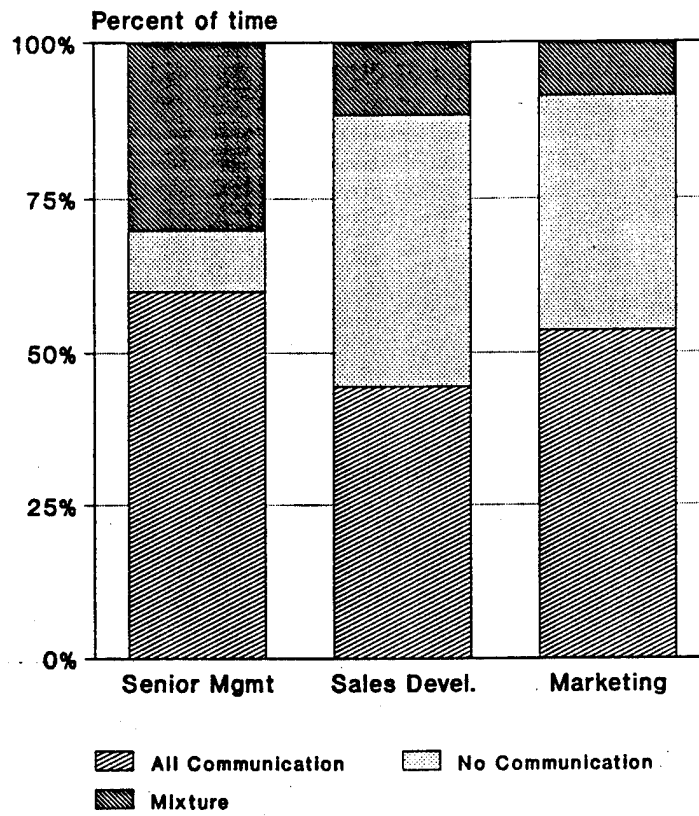
Figure 9.9   Communicative Structure of Episodes

These additional analyses all point to the significant differences in the nature of work among the targeted groups in CSD. These differences are both a function of workstyle and the social context within which work is accomplished. As we have seen, the Senior Management group has fewer opportunities to work on parallel aspects of the same task. This is partly a result of their individual responsibilities for the oversight of their own sections and thus fewer opportunities to work on the same task, but also a result of having relatively less time to focus on any specific task. In addition, demands on their time are such that their opportunities to work on any task is more frequently interrupted and their efforts to secure solitary time to complete work on any given task frustrated by a continuing stream of activity. In the chapter which follows we will again address these issues as we summarize the theoretical conclusions of the research.

10.0 THEORETICAL CONCLUSIONS: TOWARDS A THEORY OF INDIVIDUAL AND GROUP COMMUNICATION AND WORK

This project has attempted to increase understanding of cooperative work and has focused primarily on interrelated factors of workgroup style, communication, and the role of channel choice and channel switching behaviors as part of the process of group work. Tasks, events and episodes which comprise cooperative work have been the base of this study and we have given careful attention to the spatio-temporal environment which enables and constrains the accomplishment of that work. We have also looked closely at the role of group work style as a variable which influences the flow of activity within any group. This, in turn, required a careful analysis of the constituent parts of the cooperative work process. Finally, we have examined the ways in which various communication channels (and the individual choices individuals and groups make among a range of alternatives) facilitate the accomplishment of work tasks within groups. This chapter will highlight the key theoretical conclusions of the study.

10.1 Multitasking and social architecture

Individuals engage in numerous tasks and interact with many individuals during the course of the workday. The intertwining of these tasks and interactions weave a fine fabric of activity for both the individual worker and the workgroup as a whole. Our methodology enabled us to examine this fabric as a whole workday -- in which tasks and interactions comprise a large array of activities -- as well as an ongoing, dynamic context and set of constraints within which the individual continually acts and makes choices in order to accomplish his or her work.

Several measures were developed for tracking the richness and complexity of this fabric of activity as the individual moves through a workday. Using the task-event as a basic unit of observation and analysis, marked workgroup differences were found in the extent of the "compounding" of time into "episodes" in which the threads of multiple activities, interactions and communication channels cross. Other measures of ongoing activity characterized the extent to which individuals "multitask" their many ongoing activities. Variations in the extent of both individuals' multitasking and time-compounding reflect and constrain the ways in which they organize and manage their time and activities.

The multitasking metaphor is particularly useful for considering the relationship between patterns of individual activities and workgroup communication. At any given moment, a number of tasks may be temporarily suspended when another presumably more pressing task is addressed. Later, the second task may be completed or temporarily suspended when the first task is resumed. In this sense an individual maintains a "stack" of activities and the workday becomes partly a process of managing the competing urgencies of different tasks. Such strategies are instrumental in weaving the fine fabric of activity within the context of the work site. Thus the relationships between the ways in which individuals manage their "stacks" of activities and the patterns of communication they maintain with fellow workgroup members are also key features of the process of group work. Indeed, attributes of tasks (e.g., extent to which they are impaired by interruptions), communications systems (e.g., availability of synchronous and asynchronous counterparts), workgroups (e.g., collocated or dispersed) and of established patterns of interaction and coordination shape and are shaped by patterns of multitasking.

163

The particular pattern of multitasking operative in a group has much to do with its perceived and experienced style of operation. Different roles within a group (e.g., manager, administrative assistant, receptionist) have distinct rights and obligations as far as interrupting, directing, prioritizing or coordinating other members' activities; sometimes these rights and obligations serve to "protect" other members from unwanted interruptions, unmanageable "stacks" and workloads. This underlying organization can be thought of as the *social architecture* of the group, and our research indicates there are profound organizational differences in prevalent/preferred social architectures of workgroups. Two broad categories of architecture are evident in this study: collaborative and coordinative architectures. Collaborative architectures are marked by the minimizing of differences among group members' status and rank, by increasing solidarity and shared goals and task assignments, and by a high degree of interactive accomplishment of tasks. Coordinative architectures, on the other hand, are characterized by clear distinctions of status and hierarchy, divisions of labor among tasks across members of the group, and by a low degree of interactive accomplishment of tasks.

10.2 Group work style and the organization of individual activity

The measures and observations of activity described in this study captured important temporal dimensions of how individuals organized their activities, but also exhibited patterned differences among the members of the studied workgroups. We propose that these patterned differences among the observed workgroups reflect important qualitative differences in the "styles" with which the groups perform their work.

Our quantitative measures seem to capture the dimensions of temporal organization and communication channel usage underlying group work style. There are, to be sure, other important dimensions of group work style which are not picked up directly by these measures (e.g., workgroup values, leadership style). But what is of central interest here is the fact that our measures are sensitive to factors that lie in the interface between the organization of individual and workgroup-level activity. The individual-level multitasking results, for example, clearly reflect differences in the workgroups to which individuals belong.

An important question thus emerges: What is the nature of the relationship between individual and workgroup activity? The theoretical framework we are developing to address this issue begins from the observation that individuals in office settings routinely must resolve conflicts between (1) having uninterrupted periods of time in which to get their own work done and (2) being accessible for communication to others with whom they work. This conflict, office workers frequently experience and discuss, generates a tradeoff between having uninterrupted time for doing solitary work and being accessible to others for communication, coordination and collaboration.

Individual workers may be frequently observed attempting to manage or alter this tradeoff. Asking a secretary to screen one's calls, closing one's office door, forwarding one's phone, and so forth, are all strategies (requiring enabling technologies or individuals) for managing the tradeoff. It is precisely this interplay between communication and solitary activity which our analyses of the shadowing data portray so closely. And, we argue, it is exactly at this level that major differences among group work styles may be readily characterized.

One factor constraining the relationship between the group and the individual is the nature of the work itself. The work which groups carry out varies widely, of course, and in turn influences the way in which it is (or ways in which it might be) divided up among group members. The nature of the work also determines in part how problematic interruptions may be to its accomplishment; some tasks, such as copying numbers onto a chart from a table, are less degraded by interruptions than are other tasks, such as writing a complex report.

The need to address several tasks at once we have referred to as multitasking, and the conceptual framework for and measurement of individuals' multitasking behavior are important empirical and theoretical outcomes of the research. Our measures, rough as they are in this initial invocation, seem to capture both variations in individuals' organization of activities as well as major qualitative differences among the organization of activity within workgroups. The variations in the extent of and need for such multitasking behavior needs to be mapped out across a much broader range of workgroup, office environment and industry contexts.

There are thus strong mutual constraints among (1) the nature of the group's work; (2) the ways in which it is divided up among workgroup members; (3) the modes of coordination and collaboration required to make that division of labor effective; and (4) workgroup members' relative needs for communication and solitary activity to accomplish their work. Information system and communication technologies play a crucial role in these tradeoffs. In one *workgroup design* (i.e., a division of labor and specification of collaboration and coordination modes), an interactive but asynchronous technology such as electronic mail may be very facilitating, supporting communication while not increasing the interruption of solitary activity. In another workgroup design, however, electronic mail may be of less value, e.g., the crucial tradeoff is between meetings and travel. There are several other factors that affect the "fit" of a technology to a workgroup design, as well (e.g., travel patterns, other channels available, accessibility of the system, etc.). We are not overlooking such factors in this discussion, but rather adding a new one that must be considered as well. Without going into further details at this point, it is important to emphasize that workgroup and organizational design (in the above sense) and the implementation/customization of "group-friendly" technologies must be developed together.

10.3 Coordination and collaboration

In order to better understand the nature of the contrasts in work patterns and communication styles among the studied workgroups, it is useful to stop and consider in more detail some of the structures of work. Work consists of both solitary tasks -- ones that are accomplished by a single individual -- and cooperative tasks -- ones where accomplishment involves multiple individuals. We have observed cooperative work to occur in two major modes: coordinated and collaborative.

Solitary work is diagrammed in figure 10.1. The task (A) is started, processed and completed by the same person[1]. An artist, for example, working alone in a studio is doing solitary work.

Coordinated work, however, is accomplished through a multi-person process of labor which is divisible into distinct pieces. Coordinated work may take different forms though the process is essentially the same. The structure of labor on the task is first coordinated by a person or mechanism and then workers perform their assigned segments of the task independently. The coordinated work may proceed synchronously (Figure 10.2) or asynchronously (Figure 10.3). An assembly line is a simple example of one type of work which fits into the asynchronous category.

In contrast to coordinated work, collaborative work requires the ongoing, active interaction of two or more workers in order to accomplish the task (Figure 10.4). In collaborative work the process of labor is indivisible. An example of collaborative work would be a face-to-face brainstorming session.

Working from these basic definitions it, follows that solitary work is the basic unit of work and does not involve coordination or collaboration. Coordination, however, will involve solitary work. Returning to the example of the assembly line, a worker is still responsible for a solitary task(s) which is coordinated with other solitary tasks resulting in a product of some type. Collaboration, on the other hand, may exist as a discrete type of work as in the brainstorming example above or phase between collaborative, coordinated and solitary types of work (Figure 10.5). During collaborative work the intensity of the interaction between workers reaches a peak, and then returns to one of the other two modes.

The "phasing" of solitary work, coordination and collaboration can be illustrated in the structure and function of a basketball team. There are distinct positions (existing roles) which are assigned by the coach. The coach will instruct the players in how to play their roles (coordinate the individual players' solitary work) in accomplishing the task (winning a game), but that instruction may not be enough to ensure a win. Once the game begins, the task becomes much more complex in that the contingencies of the game are to a large degree unpredictable. For the team to win the players must collaborate. Collaboration requires the roles be placed in the background and that players are able to try new combinations of offensive and defensive moves as the game progresses. The key to success is to do their individual jobs (solitary work) but not only in unison (coordinated work); they must go beyond merely acting out the assigned role and integrate their work so that they interact as a single unit (collaboration). This is not to say that the solitary or coordinated work disappears when the game begins, but that only collaboration will produce the synergy which is necessary for the team to play at its highest level.

These characteristics of solitary, coordinated and collaborative modes of work can be analyzed in terms of a series of contrasting dimensions (Figure 10.6)[2]. The first three dimensions relate to the social structure of work and involve roles, management, and responsibility. In solitary work, the role and task are in a sense inseparable. The worker addresses the task in isolation, manages the task without direction or assistance and is solely responsible for the completion of the task. Coordinated work involves tasks which are assigned by a coordinator or supervisor

[1] The development of this section owes much to the discussions of work flow and group cooperation by Thompson (1967), Van de Ven, Delbecq and Koenig (1976) and Little (1989).

[2] Though idealized here as pure forms, these are nonetheless characteristic of the various types of work.

166
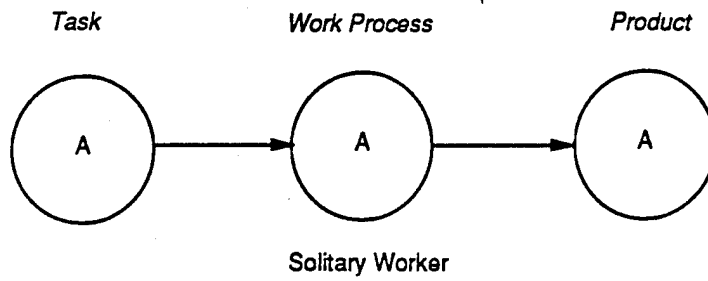
Figure 10.1   Solitary Work
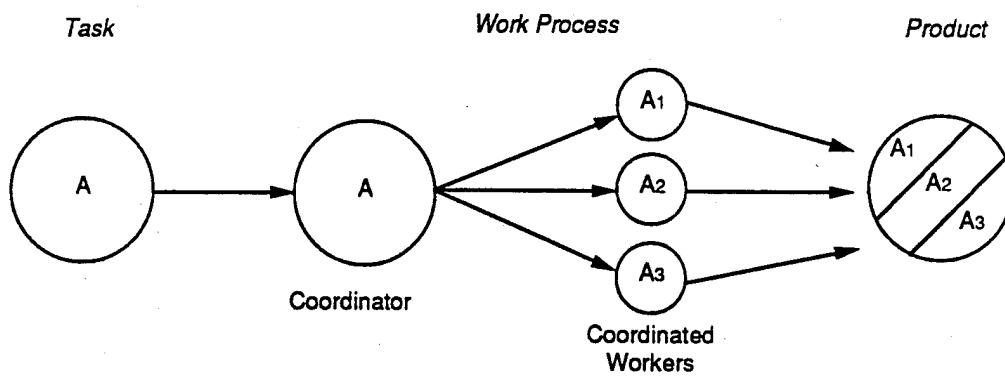
Figure 10.2   Coordinated Work: Synchronous
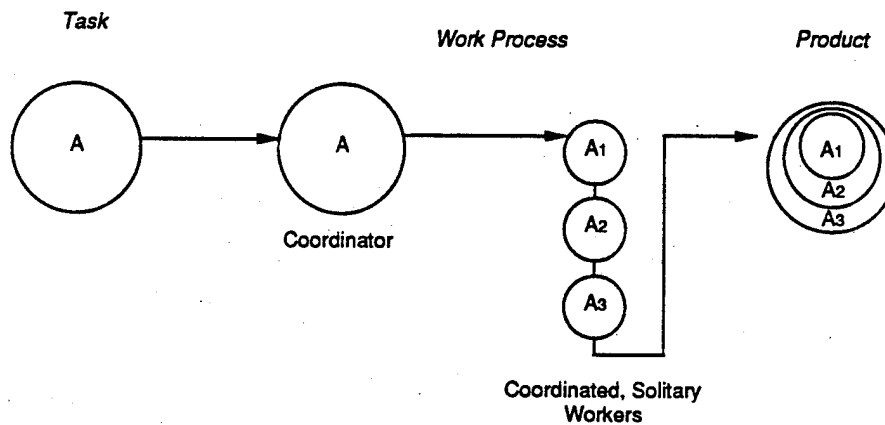
Figure 10.3   Coordinated Work: Asynchronous

Task   Work Process   Product
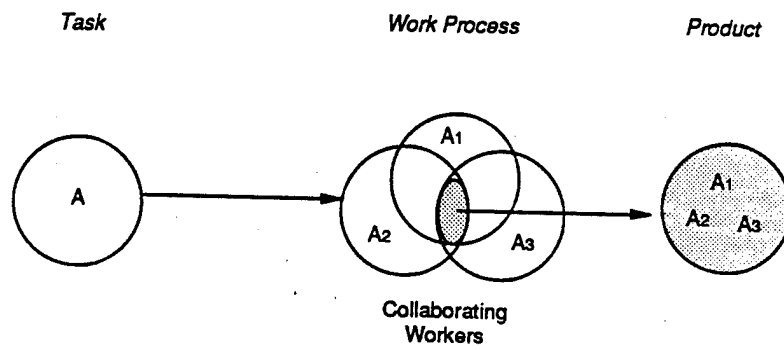
Figure 10.4   Collaborative Work

Task   Work Process   Product
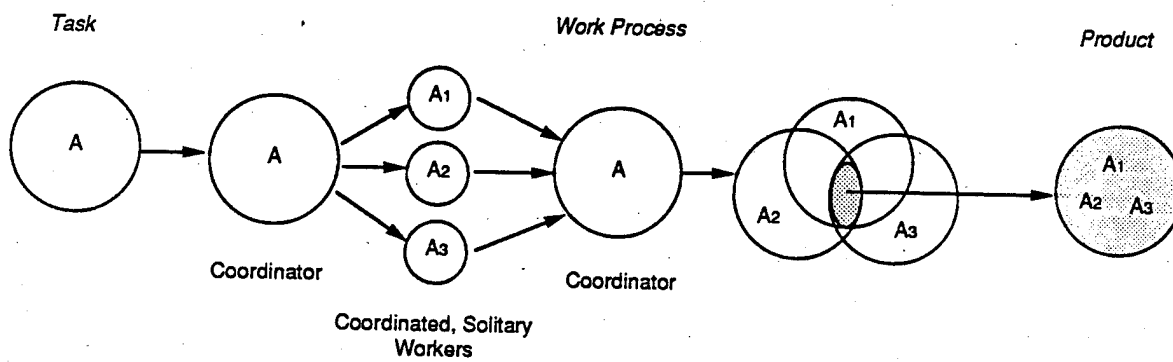
Figure 10.5   Coordinated, Solitary and Collaborative Phases of Work

168

Dimensions	Solitary work	Coordinated work	Collaborative work
Role	role in task is determined by task; no exposure of work to other workers	role in task is assigned by coordinator; low exposure of work to other workers, high to supervisor	role in task is negotiated by peers; high exposure of work to co-workers
Management	worker manages task	workers are managed to accomplish task	workers manage task
Responsibility	responsibility for task is taken by individual workers; no obligation to co-workers	responsibility for task is assigned by coordinator; low obligation to co-workers; high obligation to coordinator	responsibility for task is shared by workers; high obligation to co-workers
Interactions	interactions with others tend to be minimal, opportunistic, and information-based; low interactional intensity	interaction with others tends to be minimal, scheduled, directive, and separate from process of work; moderate interactional intensity	interaction with others tends to be non-directive and integrated with task; high interactional intensity
Output (product)	product (output) "stands alone"	product (output) is part of a set of related pieces	product (output) is integrated, not separable into pieces
Context Sensitivity	insensitive to time, space, channel	low sensitivity to time, space, channel	extreme sensitivity to time, space, channel

Figure 10.6 Contrasts Among Modes of Work

and completed largely or totally without the assistance of others. In coordinated work, workers have little or no direct and immediate responsibility to anyone other than the task coordinator. Collaborative efforts, however involve a sharing of responsibility and high level of obligation to co-workers. The workers manage the task and share insights, and negotiate individual roles within the larger context of group work.

The next two dimensions sketch the process of work for the three modes focusing on the nature of interaction with other workers and the output (product) of the work process. Solitary work involves a low level of task-related intense interaction with others in the work environment. When interactions do occur, they are not usually an integral part of the task but tend to be informational in nature. The "product" of solitary work efforts are self contained and discrete. Interactions for individuals performing coordinated work tend to be of moderate intensity. These interactions are usually scheduled and directive and not part of the process of work. Since coordinated tasks are essentially discrete but interrelated, that which is produced by any single worker is a part of a larger cluster of separate but related products. Collaborative interactions, in contrast to solitary and coordinated types, are of high interactional intensity. Because each worker is responsible to every other team member, interactions are typically non-directive and highly integrated. Similarly, the products of collaborative efforts are integrated wholes, not easily separable.

The last dimension, context sensitivity, refers to the degree to which the process of work is degraded by variations in the context of that work (i.e., if the work is affected by variations in time, spatial distribution or use of communication channel among the workers). Solitary work is comparatively insensitive to such variations. Where task-related interactional intensity is low, a worker retains a high level of control over the task and since co-workers are not involved in the product of the task, issues of time, space and communication channel are usually not significant. Coordinated tasks, however, are dependent on some degree of communication between a supervisor and worker or between independent workers and thus may be subject to a low level of degradation when communications vary in time space or channel. For example, messages between a worker and a supervisor which are pass through an asynchronous channel such as electronic mail may be delayed and thus delay instructions necessary for the completion of work. Severe degradation of task outcomes is possible when collaborative work is underway. Because of the high level of interactional intensity required of collaborative workers, disruptions to that interaction resulting from temporal, spatial or channel choices variations in communication can have serious consequences. Such variations need not always have negative consequences, however. Carefully chosen technologies can provide flexibility and can enhance the abilities of workgroup members to collaborate.

As we have shown, collaboration is a mode of work which is most effective when the roles of the collaborators are peer-like.[3] For groups with strict status hierarchies and rigidly defined roles, collaboration appears to be more difficult to achieve. On the other hand, coordination is by definition a directive process and so is often the normal work mode for hierarchical organizations. It appears there are impediments to increased collaboration among groups with strict role hierarchies. For example, turning again to the Convex Systems Division described in chapters 6 and 7, while coordinative work is common among the Senior Management Group, it appears difficult for group members to shift into a collaborative mode. This is not to say it is impossible, or never happens, but that collaboration could be enhanced if a means

---

[3]   Please refer to section 4.2 for a full discussion of the contrasts among the modes of work.

were developed to enable group members to negotiate their own roles and manage the group tasks at hand. For example, one transition between a coordinative and collaborative mode in a senior Management Team meeting was effected by the General Manager rising from the table and facilitating a budget recast session using a chartpak. By physically taking himself out of his position at the head of the table and assuming the role of meeting facilitator, he effectively changed the tone of the meeting and a collaborative effort ensued.

This example points to an opportunity for system designers since technology could be a key mechanism for facilitating collaboration. There are also opportunities for System designers to facilitate coordination through technological means. System designers, however, should move cautiously. As discussed above, collaboration is often a stage in the work process; systems which strive to coordinate group work by managing tasks and assigning roles could well disable the ability of the group members to collaborate by locking group members into an inflexible set of tasks and roles.

Looking at the Sales Development group, on the other hand, another variable comes to the surface. As our observations indicate, the interactional intensity required for collaborative work is much more difficult to achieve and sustain when members of workgroups are geographically and virtually dispersed. Thus the communicative feedback necessary for effective collaboration tends to be routed through channels which are less rich than face-to-face interaction. The Sales Development group, for example, is unable to have regular face-to-face communication because they are geographically dispersed. The result is that they must depend on the telephone, electronic mail, and other channels which are by comparison "information poor." Our observations suggest that the subtle and ongoing negotiations in role and task responsibility which are a part of collaborative interaction are assisted by "information rich" channels. Thus the challenge is to enrich and expand available channels in order to enhance opportunities for feedback. It is not being suggested, however, that this feedback need always be synchronous. In many cases collaboration may be enhanced even when only asynchronous communication is possible.

In contrast to the Senior Management and Sales Development groups, the Marketing group operated as a peer-like group and so was better able to shift among solitary, coordinative and collaborative work modes. At the same time, their being located in the same office allowed rather than forced choices of communication channels for intra-group communication. Consequently, the observed incidence of collaboration was highest among the members of this group.

10.4 Channel choice and channel switching

The ubiquity of multichannel communicative chains--not only in our shadowing data, but probably in most work settings--is an important feature of workgroup activity and communication[4]. The very high rate of channel switching observed for all five workgroups in this study is fundamental to understanding workplace communication patterns. Though there are characteristic patterns, our research suggests that channel choice and switching behaviors can only be fully understood in the wider context of the communicative economy of the workplace, against the backdrop of workgroup activity and workstyle.

---

[4] This material has been developed much more fully in Reder and Schwab 1989.

all five workgroups in this study is fundamental to understanding workplace communication patterns. Though there are characteristic patterns, our research suggests that channel choice and switching behaviors can only be fully understood in the wider context of the communicative economy of the workplace, against the backdrop of workgroup activity and workstyle.

Channel choice is firmly and deeply embedded in the context of the work setting. Each choice is made among and in consideration of a limited set of available channels with distinct and specific qualities. For example, the decision to communicate by way of a synchronous rather than an asynchronous channel or by way of an electronic rather than or hardcopy message has implications most workers are keenly aware of. Similarly, channel choice and channel switching behaviors are clearly bound to aspects of communicative strategy. As our observational data indicate, workers employ varying channels with obvious strategic intent (e.g., an asynchronous channel might be used to reply in order to "buy time"). While there is wide variation among members of workgroups in terms of individual channel preference, choices remain constrained by the wider context of policy, procedure, group values, style and local rules of usage.

Another important way to understand the phenomenon of channel choice and channel switching behavior highlighted in this study is to focus on genres of communication. Examining the distinctive genres of communication characteristic of the studied workplaces, this study paid careful attention to the association of specific genres and channels. Of interest was the existence of multichannel genres of communication and the relation of this phenomenon to channel switching. While most "conversations" tend to remain within a given channel for their duration, there are marked channel transitions exhibited within some conversations (e.g., from electronic mail to face-to-face conversation). The results of this study indicate these multichannel genres of communication may be more readily apparent when computer mediated communication is a significant part of the communicative economy of the workplace. Results of the study reveal that channel choices and switching are patterned in relation to the physical environment, topics of discussion, size and composition of particular groups, and the social motivations of the participants.

The frequently observed temporal compounding of tasks is consistent, at the activity level, with Bowers and Churcher's (1989) conception of conversations being a patchwork of temporally intertwined "strips", each of which is *locally managed* (and analyzable by existing discourse analytic methods), but the totality of which is structured on a more global level. This higher level, according to our findings, is structured in part by the dynamics of multitasking, temporal compounding, workgroup design and usage of multiple communication technologies. Thus we suggest there is a need to reexamine the fundamental relationship between language and action in the workplace. Existing techniques, based on a tacit assumption that conversation is sorted out into a sequence of "strips", each of which is focussed on a single task, are unrealistic (e.g., Winograd 1986). These techniques will not be able to handle the many switches and intertwinings of task and channel that our data indicate are fundamental features of workplace communication.

11.0 APPLICATION OF FINDINGS AND IMPLICATIONS FOR ARI

There are three key interrelated areas in which the findings of this study have direct implications for ARI. First, this study should be used to inform the <u>design of systems</u> to support communication. Second, <u>organizational design</u> should be examined and adapted in light of the findings presented above. Third, findings from this study suggest several ways to <u>enhance organizational effectiveness</u> through an emphasis on the processes of coordination and collaboration, revisions of policies and procedures, and more effective training strategies.

11.1 Design of Communication Support Systems

Technologies have allowed members of workgroups opportunities to work together in radically new ways. Most significantly, such groups are no longer constrained by space and time. Yet the ability of members of workgroups to accomplish tasks remains constrained by a wide range of factors. For members of such groups, communication is a key yet complex variable; this is especially true for distributed groups. As the data presented above indicate, the communicative interactions of members of workgroups are structured not only by spatial considerations but also by considerations of time, roles and personal and organizational style. These and other factors, however, are in turn shaped and constrained by the availability of and access to technologies which support those communicative interactions. In this section, research implications pertaining to the design of communication support systems will be discussed.

11.1.1 Support multichannel genres of communication and channel switching.
The frequent switching among channels over time as individuals work together on a given task has sharp implications for the design of supportive technologies. As we have shown in this study, much of the substance of group work is communicative, and group communication is often comprised of "conversational chains" involving multiple channels. Synchronous integration of multiple media is now being developed by several vendors in the workstation market, but capabilities must be developed for transposing communication from one medium to another and for integrating multimedia events across time (i.e., asynchronous integration). This capability is especially important in command and control settings where large volumes of information must move between coworkers in distributed sites.

For interface designers, this finding is particularly important. It indicates that the multimedia approach to workstation design is definitely the right development approach. Technological support for workgroups will not likely be useful if workgroup members must radically alter their natural patterns of communication just to take advantage of the support available for a limited range of channels. The results further indicate that the design of such technologies must consider <u>asynchyronous integration</u> of channels and interactions as well as the synchronous integration now being developed for multimedia workstations.

11.1.2 Support remote access to communication and information technologies.
Given the extensive travel, spatial dispersion and tendencies to work from home or other remote sites which some workgroups exhibit, facile remote access to office-based communication and information technologies will be essential for purposes of work continuity across environments. Information system and communication technologies must reduce the discontinuities among cross-work settings rather than

amplifying them as they most often do now. There will continue to be an unfavorable benefit/effort ratio for electronic mail, group scheduling/calendaring and other current commercial "groupware" products (let alone a new generation of applications) in the many workgroups and organizations in which such cross-work setting discontinuities of system access exist. Interfaces to these technologies must be designed to minimize such cross-setting discontinuities in access.

11.2 Organizational Design

Closely linked to the design of technologies to support group work is the design and reorganization of task groups and organizations themselves. Organizational studies have long suggested that restructuring and reorganization is the norm and not the exception for most organizations and that the need for flexibility and response to shifting demands is continuous. In attempting to design organizations, whether in response to or anticipation of change, the results of this study suggests several dimensions of group work that should be considered.

11.2.1 Support users and non-users.
It is clear from observing the various workgroups in this study, as well as from many other studies, that individual members of workgroups and organizations vary widely in their access to, preferences for and utilization of various communication and information system technologies. These individual differences -- sometimes manifested as differences in the speed with which technological changes are disseminated through an organization -- are often crucial to the effective implementation of a new technology. Although it may sometimes be the case that all members of a workgroup or organization will adapt a new technology at once (either by desire or directive), more often than not the functional incorporation of the technology into workgroup or organizational activities takes place incrementally over time.

When incorporation of new technologies is phased or incremental, the technology must offer a group interface which facilitates its use (either directly or indirectly) by both users and non-users. Grudin (1988) makes the further point that the balance of benefit/effort among users and non-users must be sufficient to assure that all workgroup members are well motivated to incorporate the use of the technology into their activities. Within an electronic mail system, for example, it should be very easy to send copies to users and non-users alike, which in the case of non-users or users with poor system access, are automatically transposed to other media/technologies for distribution (e.g., hardcopy, fax). Further, the ways in which the technology must support communication between users and non-users should be a central concern in customizing and implementing the technology within the workgroup or larger organization.

11.2.2 Support individual multitasking.
One of the key attractions of new communication technology is the promise of improvements in productivity. Although an array of commercial computer software is currently being developed to support individual and workgroup-level scheduling and project management, none of these products addresses a major need identified in our research: behavioral (as opposed to a computer operating system's) multitasking. Multitasking by humans holds significant promise for improving both individual and workgroup-level productivity.

Some fairly traditional calendar/scheduling tools can assist individuals to manage their time (in principal), but they do not assist workgroups to manage members'

time so as to provide sufficient periods for both solitary work and communication for needed coordination and collaboration. This, however, is the core problem for facilitating and supporting multitasking, and new constructs and constraints need to be recognized and represented in order for a new generation of software to be useful for such purposes.

Although our results indicate the extent and variation of multitasking, its likely impact on the efficiency with which activities are performed is only anecdotal at this point and requires further investigation. There are two areas of inquiry that seem most pressing.

First, as we have discussed above, it seems likely that some types of work are inherently more interruptible than others. Complex meetings, reports and analytical activities, for example, seem to be highly degraded by frequent interruptions; e.g., one cannot write a complex report efficiently in small slices of time. Other activities may be less degraded by interruptions. A systematic line of inquiry could substantiate these intuitions and develop measures of task degradation due to interruptions.

A second line of inquiry would look at the management and impact of behavioral multitasking itself (rather than the impact of interruptions *per se*). One facet of this inquiry would examine the strategies individuals use to "stack" and "batch" multiple ongoing activities, and the impact which such strategies have on their work and (through coordination and collaboration with others) on that of their workgroup. We would expect, from this line of inquiry, that both advances in organizational design and in technological systems to support groupwork within such organizations are possible which can facilitate individuals' multitasking operations. A related issue concerns individuals' *perceptions* of their own multitasking behaviors and their impact. There are at least two kinds of systematic misperceptions (or illusions) individuals tend to have about the effectiveness of their own multitasking activities (and here we would like to acknowledge the humorous contribution of Stan Kelly-Bootle, 1989): the "I'll-floss-while-I-eat" illusion, and the illusion that as an individual is multitasking, each activity in turn has the individual's undivided resources and attention (and therefore is performed as efficiently as if there were no multitasking taking place).

11.3 Enhancement of Organizational Effectiveness

New insights into the nature of group work, the role of communication and technology have significant implications for organizations, and there are several areas in which the results of this study can enhance organizational effectiveness.

11.3.1 The interplay of technology and group architecture.
Organizational policies, procedures and training strategies must reflect recognition of the fact that workgroups are not static structures but continually adjust to new problems, opportunities, and other social, structural or technological changes in the environment. The workplace, whether it is an office, factory, command center or field setting is first and foremost a social environment, and gains in effectiveness and efficiency can only be obtained when the social context is incorporated into analyses of workgroup performance. When this is done, communication support systems can be designed to either fit the structure and style of the group or effect transformation of the group.

It is also important to recognize that the deployment of communication and information technologies in different contexts will likely result in distinct social valuations. Thus, designers should explore the development of interfaces to these systems which are specific to alternative modes of cooperation among workgroup members. For example, our research suggests (based on study of only a limited inventory of workgroups thus far) that implementation of coordination within a workgroup may hinder the implementation of collaboration among its members, and vice-versa. The fact that coordination and collaboration modes generally depend on distinct sets of social roles within a given workgroup is a finding that has many important implications. The suggestion in our data that information and communication technologies may (be used to) effect transitions from one cooperative mode (based on one set of social roles within the group) to another (based on a different set of social roles within the group) is particularly important.

11.3.2 Facilitating appropriate modes of work. Groups are organized and structured to accomplish particular tasks. It is often the case that the structure of a task group is treated as a given, an artifact of the dictates of the task. In many cases, the structure of the group is in fact an artifact of policy or tradition and its relation to group performance is left unexamined. For example, there is clearly a tendency for organizations to direct group processes, to implement coordinated rather than collaborative activities. While this pattern tends to fix the point of control within the organization, it blocks potential gains from collaborative approaches to tasks. This is not, however, to suggest that clear decision-making hierarchies are not sometimes necessary. Linde's research on cockpit communication suggests that unequivocal coordination is essential in some command and control settings (Linde 1988), i.e., under certain conditions it is imperative that tasks are clearly assigned and completed with no negotiation of group roles or responsibility. In other situations, our research suggests, insistence on strict coordination hinders the ability of the group to produce the creative solutions which spring from the process of collaboration. The challenge is in balancing the need for coordination through command and control with the benefits of the less hierarchical but more creative collaborative approach to problem solving. Policies, procedures and training programs should incorporate a careful analysis of the relationships between these variables. With great care, support for both modes can be successfully implemented.

REFERENCES

Austin, J. (1962). *How to do things with words*. Oxford: Clarendon Press.

Barker, R. & Wright, H. (1949). "Psychological ecology and the problem of psychosocial development." *Child Development*. 20: 131-143.

Barker, R., & Wright, H. (1951). *One boy's day*. New York: Harper & Row.

Barker, R., & Wright, H. (1955). *Midwest and its children: The psychological ecology of an American town*. New York: Harper & Row.

Bauman, R. and Sherzer, J. (1975) "The ethnography of speaking." *Annual Review of Anthropology*. 4: 95-119.

Bodensteiner, W. (1970). *Information channel utilization under varying research and development project conditions: An aspect of inter-organizational communication channel usages*. unpublished Ph.D. dissertation, The University of Texas.

Bowers, J. & Churcher, J. (1989). "Local and global structuring of computer mediated communication: Developing linguistic perspectives on CSCW in Cosmos." *Office: Technology and People*. 4(3): 197-277.

Bullen, C. & Johansen, R. (1988). *Groupware: A Key to Managing Business Teams*. Technical Report, MIT Sloan School of Management, Cambridge, MA.

Conklin, N., Schwab, R., & Reder, S. (1987). *Selection and Effects of Channels in Distributed Communication and Decision-Making Tasks*. Portland, OR:Northwest Regional Educational Laboratory.

Daft, R., & Lengel, R. (1983). *Information richness: A new approach to managerial behavior and organization design*. (Report No. TR-ONR-DG-02). Department of Management, Texas A&M University.

Dubinskas, F. (1988). "Janus organizations: Scientists and managers in genetic engineering firms." In Frank A. Dubinskas (Ed.) *Making time: Ethnographies of high technology organizations*. (pp. 170-232). Philadelphia: Temple University Press.

Fowler, G., & Wackerbarth, M. (1980). "Audio teleconferencing versus face-to-face conferencing: A synthesis of the literature." *The Western Journal of Speech Communication*. 44: 236-252.

Glaser, B. & Straus, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Aldine.

Grudin, J. (1989). "Why groupware applications fail: problems in design and evaluation." *Office: Technology and People*. 4(3):245-264.

REFERENCES (Cont.)

Hall, E. (1966). *The hidden dimension*. New York: Doubleday.

Heimstra, G. (1982). "Teleconferencing, concern for face, and organizational culture." In M. Burgoon (ed.) *In Communication yearbook 6*. (874-904). Beverly Hills, CA: Sage.

Hymes, D. (1972) "Model of The interaction of language and social life." In: J. Gumperz and D. Hymes (Eds.), *Directions in Sociolinguistics*. New York: Holt, Rinehart & Winston.

Hymes, D. (1962). "The ethnography of speaking". In: T. Gladwin and W.C. Sturtevant (Eds.), *Anthropology and Human Behavior*. Washington, DC:Anthropology Society of Washington.

Kelly-Bootle, S. (1989. "Let no man steal your time...." *Computer Language*. 83-89.

Klemmer, E. & Snyder, E. (1972). "Measurement of time spent communicating." *Journal of Communication*. 22: 142-158.

Lewin, K. (1951). *Field theory in social science*. New York: Harper.

Linde, C. (1988). "The quantitative study of communicative success: Politeness and accidents in aviation discourse." *Language in Society*. 17: 375-399.

Little, Judith Warren. (1989). *The persistence of privacy: Autonomy and initiative in teachers; professional relations*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Mintzberg, H., Raisinghani, D., & Theoret, A. (1976). "The structure of "unstructured" decision processes." *Administrative Science Quarterly*. 21: 246-75.

Mintzberg, H. (1973). *The nature of managerial work*. New York: Harper & Row.

Parsons, T. (1949). *The structure at social action*. New York: Free Press.

Reder, S. & Schwab, R. (1989) "The communicative economy of the workgroup: multichannel genres of communication." *Office: Technology and People*. 4(3): 177-195.

Rice, R. (1984). The new media: Communication, research and technology. Beverly Hills, CA: Sage Publications.

Schwenk, C. (1985). "The use of participant recollection in the modeling of decision processes." *Academy of Management Review*. 10(3): 496-503.

Searle, J.R. (1969). *Speech Acts*. Cambridge: Cambridge University Press.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. New York: John Wiley & Sons.

REFERENCES (Cont.)

Short, J., Williams, E., & Christie, B. (1976). "Enhancing organizational research utilization: The Role of decision makers assumptions." *Academy of management Review*. 9(1): 18-16.

Snyder, N. & Glueck, W. (1980). "How managers plan-the analysis of managers activities." *Long Range Planning*. 13: 70-76.

Sproull, L. (1984) "Managing Education Programs: A Micro-behavioral Analysis". *Human Organization*. 40(2): 113-122.

Sproull, L. (1984) "The Nature of Mangerial Attention." *Advances in Information Processing in Organizations*. 1: 9-27.

Thompson, J. (1967). *Organizations in action*. New York: McGraw-Hill.

Traweek, S. (1988) "Discovering machines: Nature in the age of its mechanical reproduction." In Frank A. Dubinskas (Ed.) *Making time: Ethnographics of high-technology organizations*. (pp. 39-91). Philadelphia: Temple University Press.

Van de ven, A., & Delbecq, A. & Koenig, R. (1976). "Determinants of coordination modes within organizations." *American Sociological Review*. 41: 322-338.

Weber, M. (1947). *The theory of social and economic organization*. New York: Oxford University Press.

Williams, E. (1977). "Experimental comparisons of face-to-face and mediated communications: A review." *Psychological Bulletin*. 84(5): 963-76.

Williams, E. (1978). "Social and psychological factors." *Journal of Communication*. 28: 125-31.

Willis, Paul. (1977). *Learning to labour*. Farnborough: Saxon House.

Winograd, T. (1986). "A language/action perspective on design of cooperative work." *Proceedings of Conference on Computer-Supported Cooperative Work*. Austin, TX., 203-220.

APPENDIX A -- NUMERICAL QUANTITIES (CHAPTER 5)

Table 5.1 -- Time Spent in Proximity of Desk

Workgroup	% Time in Vicinity of Desk
Component	72.34
Integration	67.85
ALL	69.40

Table 5.2 -- Tasks per Day

Workgroup	Mean Tasks per Day
Component	18.56
Integration	15.11
ALL	16.36

Table 5.3 -- Distinct Interactants per Day

Workgroup	Mean Interactants per Day
Component	20.44
Integration	28.43
ALL	25.52

(no Table 5.4)

Table 5.5 -- Work Activities: Episode Distribution

Activity	N	%
Face-to-face	1030	31.73
Phone	257	7.92
Email	627	19.32
Other Comm.	196	6.04
Solitary Work	1136	35.00
	3246	100.00

Table 5.6 -- Work Activities: Time Distribution

Activity	Hours	%
Face-to-face	111.35	36.76
Phone	15.52	5.12
Email	28.30	9.34
Other Comm.	5.72	1.89
Solitary Work	142.07	46.89
	302.93	100.00

Table 5.7 -- Episode Duration of Work Activities

Activity	Mean Duration (Mins.)
Face-to-face	6.49
Phone	3.62
Email	2.71
Other Comm.	1.75
Solitary	7.50
	5.60

Table 5.8 -- Workgroup Activities: Episode Distribution

	Component		Integration	
	N	%	N	%
Face-to-Face	477	36.16	553	28.70
Phone	49	3.71	208	10.79
Email	265	20.09	362	18.79
Other Comm.	53	4.02	143	7.42
Solitary	475	36.01	661	34.30
	1319	100.00	1927	100.00

Table 5.9 -- Workgroup Activities: Time Distribution

	Component		Integration	
	Hours	%	Hours	%
Face-to-Face	38.50	36.80	72.85	36.73
Phone	2.85	2.72	12.67	6.39
Email	11.75	11.23	16.55	8.34
Other Comm.	1.95	1.86	3.77	1.90
Solitary	49.57	47.38	92.50	46.64
	104.62	100.00	198.33	100.00

APPENDIX A -- NUMERICAL QUANTITIES (CHAPTER 5)

Table 5.10 -- Workgroup Activities: Episode Duration

	Component Mins.	Integration Mins.
Face-to-Face	4.84	7.90
Phone	3.49	3.65
Email	2.66	2.74
Other Comm.	2.21	1.58
Solitary	6.26	8.40
	4.76	**6.18**

(no Table 5.11)

Table 5.12 -- Episode Distribution for Communication

Channels	N	%
Face-to-face	1030	48.82
Phone	257	12.18
Hardcopy	145	9.24
Email	627	29.72
	2109	**100.00**

Table 5.13 -- Time Distribution for Communication

Channels	Hours	%
Face-to-face	111.35	69.21
Phone	15.52	9.64
Hardcopy	5.70	3.54
Email	28.30	17.60
	160.87	**100.00**

Table 5.14 -- Episode Duration of Communication

Channels	Mean Duration (Mins.)
Face-to-face	6.49
Phone	3.62
Hardcopy	1.75
Email	2.71
	4.57

APPENDIX A -- NUMERICAL QUANTITIES (CHAPTER 5)

Table 5.15 -- Workgroup Communication: Episode Distribution

	Component		Integration	
	N	%	N	%
Face-to-Face	477	56.52	553	43. 68
Phone	49	5.81	208	16.43
Hardcopy	53	6.28	142	11.22
Email	265	31.40	362	28.58
	844	100.00	1265	100.00

Table 5.16 -- Workgroup Communication: Time Distribution

	Component		Integration	
	Hours	%	Hours	%
Face-to-Face	38.50	69.94	72.85	68.83
Phone	2.85	5.18	12.67	11.97
Hardcopy	1.95	3.54	3.75	3.54
Email	11.75	21.34	16.55	15.65
	55.05	100.00	105.82	100.00

Table 5.17 -- Workgroup Communication: Episode Duration

	Component Mins.	Integration Mins.
Face-to-Face	4.84	7.90
Phone	3.49	3.65
Hardcopy	2.66	1.58
Email	2.21	2.74
	3.91	5.02

Table 5.18 -- Breadth of Interaction

Channel	# Unduplicated Interactants
All Channels	264
Face-to-Face	155
Phone	96
Hardcopy	65
Email	138

APPENDIX A -- NUMERICAL QUANTITIES (CHAPTER 5)

Table 5.19 -- Breadth of Interaction in the Workgroups

Channel	# Unduplicated Interactants	
	Component	Integration
All Channels	84	228
Face-to-Face	46	131
Phone	13	86
Hardcopy	19	50
Email	56	110

Table 5.20 -- Organizational Communication by Group

	Own Group	Division	N Company	External
Component	533	487	236	21
Integration	535	925	78	69
		%		
Component	41.7	38.1	18.5	1.6
Integration	33.3	57.6	4.9	4.3

Table 5.21 -- Organizational Communication by Channels

	Own Group	Division	N Company	External
Face-to-Face	629	654	12	3
Phone	17	89	41	47
Hardcopy	44	110	27	31
Email	378	559	21	9
		%		
Face-to-Face	48.5	50.3	0.9	0.2
Phone	8.8	45.9	21.1	24.2
Hardcopy	20.8	51.9	12.7	14.6
Email	39.1	57.8	2.2	0.9

Table 5.22A -- Channel Usage in Organizational Communication: Intra-Group

	N Component	Integration
Face-to-Face	321	308
Phone	0	17
Hardcopy	15	29
Email	197	181
	%	
Face-to-Face	60.2	57.6
Phone	0.0	3.2
Hardcopy	2.8	5.4
Email	37.0	33.8

Table 5.22B -- Channel Usage in Organizational Communication: Intra-Division

	N Component	Integration
Face-to-Face	259	395
Phone	20	69
Hardcopy	28	82
Email	180	379
	%	
Face-to-Face	53.2	42.7
Phone	4.1	7.5
Hardcopy	5.7	8.9
Email	37.0	41.0

Table 5.22C -- Channel Usage in Organizational Communication: Intra-Company

	N Component	Integration
Face-to-Face	2	10
Phone	8	33
Hardcopy	7	20
Email	6	15
	%	
Face-to-Face	8.7	12.8
Phone	34.8	42.3
Hardcopy	30.4	25.6
Email	26.1	19.2

Table 5.22D -- Channel Usage in Organizational Communication: External

	N Component	Integration
Face-to-Face	0	3
Phone	6	41
Hardcopy	6	25
Email	9	0
	%	
Face-to-Face	0.0	4.3
Phone	28.6	59.4
Hardcopy	28.6	36.2
Email	42.9	0.0

Table 5.23A -- Organizational Communication: Component Team

	Own Group	Division	N Company	External
Face-to-Face	321	259	2	0
Phone	0	20	8	6
Hardcopy	15	28	7	6
Email	197	180	27	31
		%		
Face-to-Face	55.2	44.5	0.3	0.0
Phone	0.0	58.8	23.5	17.6
Hardcopy	26.8	50.0	12.5	10.7
Email	45.3	41.4	6.2	7.1

Table 5.23B -- Organizational Communication: Integration Team

	Own Group	Division	N Company	External
Face-to-Face	308	395	10	3
Phone	17	69	33	41
Hardcopy	29	82	20	25
Email	181	379	15	0
		%		
Face-to-Face	43.0	55.2	1.4	0.4
Phone	10.6	43.1	20.6	25.6
Hardcopy	18.6	52.6	12.8	16.0
Email	31.5	65.9	2.6	0.0

APPENDIX A -- NUMERICAL QUANTITIES (CHAPTER 5)

Table 5.24 -- Organizational Communication by Interactant's Status

	Own Group	Division	N Company	External
Face-to-Face	629	654	12	3
Phone	17	89	41	47
Hardcopy	44	110	27	31
Email	378	559	21	9
		%		
Face-to-Face	48.5	50.4	0.9	0.2
Phone	8.8	45.9	21.1	24.2
Hardcopy	20.8	51.9	12.7	14.6
Email	39.1	57.8	2.2	0.9

Table 5.25 -- Communicative Chains

Chain Length	Frequency
1	430
2	119
3	53
4	34
5	16
>5	35

Table 5.26 -- Channel Switching

Chain Length	% Chains with Switch
1	--
2	29.41
3	52.83
4	55.88
5	62.50
>5	77.14

Table 5.27 -- Workgroup Levels of Multitasking (Method A)

	Stack Size	
Workgroup	Running Avg	Peak Value
Component	2.81	5.38
Integration	2.86	5.07

(no Tables 5.28 or 5.29)

Table 5.30 -- Non-Specific Activity: Episode Distribution

Workgroup	Non-mixed episodes	All non-specific episodes	% non-specific episodes
Component	1334	283	21.2
Integration	1961	340	18.9

Table 5.31 -- Non-Specific Activity: Time Distribution

Workgroup	Non-mixed episodes Hours	All non-specific episodes	% non-specific time
Component	106.99	16.50	15.4
Integration	201.62	21.49	10.7

Table 5.32 -- Non-Specific Activity: Episode Duration

Workgroup	Mean Duration (Min.)
Component	3.50
Integration	3.79

Table 7.1 -- Time Spent in Proximity of Desk

Workgroup	% Time in Vicinity of Desk
Senior Mgmt	58.61
Sales Devel.	75.48
Marketing	72.31
ALL	68.72

Table 7.2 -- Tasks per Day

Workgroup	Mean Tasks per Day
Senior Mgmt	29.56
Sales Devel.	15.40
Marketing	12.20
ALL	17.74

Table 7.3 -- Distinct Interactants per Day

Workgroup	Mean Interactants per Day
Senior Mgmt	23.89
Sales Devel.	15.00
Marketing	16.47
ALL	18.00

(no Table 7.4)

Table 7.5 -- Work Activities: Episode Distribution

Activity	N	%
Face-to-face	311	20.99
Phone	435	29.35
Other Comm.	159	10.73
Solitary Work	577	38.93
	1482	100.00

Table 7.6 -- Work Activities: Time Distribution

Activity	Hours	%
Face-to-face	68.90	39.60
Phone	29.83	17.14
Other Comm.	6.95	4.00
Solitary Work	68.31	39.26
	174.00	**100.00**

Table 7.7 -- Episode Duration of Work Activities

Activity	Mean Duration (Mins.)
Face-to-face	13.29
Phone	4.11
Other Comm.	2.62
Solitary	7.10
	7.04

Table 7.8 -- Workgroup Activity: Episode Distribution

	Senior Mgmt		Sales Devel.		Marketing	
	N	%	N	%	N	%
Face-to-Face	124	27.19	71	16.82	116	19.21
Phone	168	36.84	112	26.54	155	25.66
Other Comm.	47	10.31	45	10.66	67	11.09
Solitary	117	25.66	194	45.97	266	44.04
	456	**100.00**	**422**	**100.00**	**604**	**100.00**

Table 7.9 -- Work Activity: Time Distribution

	Senior Mgmt		Sales Devel.		Marketing	
	Hours	&	Hours	%	Hours	%
Face-to-Face	29.47	63.16	14.30	24.71	25.14	36.17
Phone	8.27	17.72	10.97	18.97	10.59	15.24
Other Comm.	1.52	3.25	2.73	4.72	2.71	3.90
Solitary	7.41	15.88	29.85	51.60	31.05	44.69
	46.66	**100.00**	**57.85**	**100.00**	**69.49**	**100.00**

APPENDIX B -- NUMERICAL QUANTITIES (CHAPTER 7)

Table 7.10 -- Work Activities: Episode Duration

	Senior Mgmt Mins.	Sales Devel. Mins.	Marketing Mins.
Face-to-Face	14.26	12.08	13.00
Phone	2.95	5.88	4.10
Other Comm.	1.94	3.64	2.43
Solitary	3.80	9.23	7.00
	6.14	**8.23**	**6.90**

(no Table 7.11)

Table 7.12 -- Episode Distribution for Communication

Channels	N	%
Face-to-face	311	34.36
Phone	435	48.07
Hardcopy	108	11.93
Other Channels	51	5.64
	905	**100.00**

Table 7.13 -- Time Distribution for Communication

Channels	Hours	%
Face-to-face	69.90	65.20
Phone	29.83	28.22
Hardcopy	4.78	4.53
Other Channels	2.17	2.05
	105.69	**100.00**

Table 7.14 -- Episode Duration of Communication

Channels	Mean Duration (Mins.)
Face-to-face	13.29
Phone	4.11
Hardcopy	2.66
Other Channels	2.55
	7.01

Table 7.15 -- Workgroup Communication: Episode Distribution

	Senior Mgmt		Sales Devel.		Marketing	
	N	%	N	%	N	%
Face-to-Face	124	36.58	71	31.14	116	34.32
Phone	168	49.56	112	49.12	155	45.86
Hardcopy.	33	9.73	26	11.40	49	14.50
Other Channels	14	4.13	19	8.33	18	5.33
	339	100.00	228	100.00	338	100.00

Table 7.16 -- Workgroup Communication: Time Distribution

	Senior Mgmt		Sales Devel.		Marketing	
	Hours	%	Hours	%	Hours	%
Face-to-Face	29.47	75.08	14.30	51.06	25.14	65.40
Phone	8.27	21.06	10.97	39.19	10.59	27.56
Hardcopy.	1.12	2.85	1.85	6.62	1.81	4.72
Other Channels	0.40	1.02	0.88	3.13	0.90	2.33
	39.25	100.00	28.00	100.00	38.44	100.00

Table 7.17 -- Workgroup Communication: Episode Duration

	Senior Mgmt Mins.	Sales Devel. Mins.	Marketing Mins.
Face-to-Face	14.26	12.08	13.00
Phone	2.95	5.88	4.10
Hardcopy	2.03	4.28	2.22
Other Channels	1.71	2.76	2.99
	6.95	7.37	6.82

Table 7.18 -- Breadth of Interaction

Channel	# Unduplicated Interactants
All Channels	214
Face-to-Face	123
Phone	143
Hardcopy	88

APPENDIX B -- NUMERICAL QUANTITIES (CHAPTER 7)

Table 7.19 -- Breadth of Interaction in the Workgroups

Channel	# Unduplicated Interactants		
	Senior Mgmt	Sales Devel.	Marketing
All Channels	109	77	86
Face-to-Face	55	39	45
Phone	69	42	56
Hardcopy	39	31	29

Table 7.20 -- Organizational Communication by Group

	Own Group	Division	N Company	External
Senior Mgmt	309	423	206	77
Sales Devel.	126	282	58	53
Marketing	174	372	57	73
		%		
Senior Mgmt	30.4	41.7	18.9	7.6
Sales Devel.	24.3	54.3	11.2	10.2
Marketing	25.7	55.0	8.4	10.8

Table 7.21 -- Organizational Communication by Channels

	Own Group	Division	N Company	External
Face-to-Face	350	455	35	30
Phone	146	332	194	124
Hardcopy	101	199	37	31
Other Channels	12	91	55	18
		%		
Face-to-Face	40.2	52.3	4.0	3.4
Phone	18.3	41.7	24.4	15.6
Hardcopy	27.4	54.1	10.1	8.4

Table 7.22A -- Channel Usage in Organizational Communication: Intra-Group

	Senior Mgmt	Sales Devel	N Marketing
Face-to-Face	231	12	107
Phone	27	97	22
Hardcopy	49	9	43
Other Channels	2	8	2
		%	
Face-to-Face	74.8	9.5	61.5
Phone	8.7	77.0	12.6
Hardcopy	15.9	7.1	24.7
Other Channels	0.6	6.4	1.1

Table 7.22B -- Channel Usage in Organizational Communication: Intra-Division

	Senior Mgmt	Sales Devel	N Marketing
Face-to-Face	196	107	152
Phone	129	102	101
Hardcopy	63	51	85
Other Channels	35	22	34
		%	
Face-to-Face	46.3	37.9	40.9
Phone	30.5	36.2	27.1
Hardcopy	14.9	18.1	22.9
Other Channels	8.3	7.8	9.1

Table 7.22C -- Channel Usage in Organizational Communication: Intra-Company

	Senior Mgmt	Sales Devel	N Marketing
Face-to-Face	25	7	3
Phone	125	40	29
Hardcopy	23	1	13
Other Channels	33	10	12
		%	
Face-to-Face	13.7	12.1	5.3
Phone	60.7	69.0	50.9
Hardcopy	11.2	1.7	22.8
Other Channels	14.4	17.2	21.0

APPENDIX B -- NUMERICAL QUANTITIES (CHAPTER 7)

Table 7.22D -- Channel Usage in Organizational Communication: External

	Senior Mgmt	Sales Devel	N Marketing
Face-to-Face	14	7	9
Phone	42	38	44
Hardcopy	11	3	17
Other Channels	10	5	3

%

	Senior Mgmt	Sales Devel	N Marketing
Face-to-Face	18.2	13.2	12.3
Phone	54.5	71.1	60.3
Hardcopy	14.3	5.7	23.3
Other Channels	13.0	9.4	4.1

Table 7.23A -- Organizational Communication: Senior Management

	Own Group	Division	N Company	External
Face-to-Face	231	196	25	14
Phone	27	129	125	42
Hardcopy	49	63	23	11

%

	Own Group	Division	N Company	External
Face-to-Face	49.6	42.1	5.4	3.0
Phone	8.4	39.9	38.7	13.0
Hardcopy	33.6	43.2	15.8	7.5

Table 7.23B -- Organizational Communication: Sales Development

	Own Group	Division	N Company	External
Face-to-Face	12	107	7	7
Phone	97	102	40	38
Hardcopy	9	51	1	3

%

	Own Group	Division	N Company	External
Face-to-Face	9.0	80.5	5.3	5.3
Phone	35.0	36.8	14.4	13.7
Hardcopy	14.1	79.7	1.6	4.7

APPENDIX B -- NUMERICAL QUANTITIES (CHAPTER 7)

Table 7.23C -- Organizational Communication: Marketing

	Own Group	Division	N Company	External
Face-to-Face	107	152	3	9
Phone	22	101	29	44
Hardcopy	43	85	13	17
		%		
Face-to-Face	39.5	56.1	1.1	3.3
Phone	11.2	51.5	14.8	22.4
Hardcopy	27.2	53.8	8.2	10.8

Table 7.24 -- Organizational Communication by Interactant's Status

	Own Group	Division	N Company	External
Face-to-Face	350	455	35	30
Phone	146	332	194	124
Hardcopy	101	199	37	31
Other Channels	12	91	55	18
		%		
Face-to-Face	57.5	42.2	10.9	14.8
Phone	24.0	30.8	60.4	61.1
Hardcopy	16.6	18.5	11.5	15.3
Other Channels	1.9	8.5	17.2	8.8

Table 7.25 -- Communicative Chains

Chain Length	Frequency
1	349
2	109
3	48
4	20
5	10
6	9
> 6	15

APPENDIX B -- NUMERICAL QUANTITIES (CHAPTER 7)

Table 7.26 -- Channel Switching

Chain Length	% Chains with Switch
1	0.0
2	44.0
3	68.8
4	80.0
5	80.0
6	88.9
> 6	93.3

Table 7.27 -- Workgroup Levels of Multitasking (Method A)

| Workgroup | Stack Size | |
	Running Avg	Peak Value
Senior Mgmt	4.73	8.00
Sales Devel.	2.52	5.00
Marketing	2.34	4.20

(no Tables 7.28 or 7.29)

Table 7.30 -- Non-Specific Activity: Episode Distribution

	Non-mixed episodes	All non-specific episodes	% non-specific
Senior Mgmt	508	120	23.6
Sales Devel.	461	60	13.0
Marketing	646	113	17.5

Table 7.31 -- Non-Specific Activity: Time Distribution

	Non-mixed episodes Hours	All non-specific episodes	% non-specific
Senior Mgmt	63.24	12.52	19.8
Sales Devel.	63.54	6.74	10.6
Marketing	78.60	7.98	10.2

APPENDIX B -- NUMERICAL QUANTITIES (CHAPTER 7)

Table 7.32 -- Non-Specific Activity: Episode Duration

Workgroup	Mean Duration (Min.)
Senior Mgmt	6.26
Sales Devel.	6.74
Marketing	4.24

Table 9.1 -- Key Task Activity

Workgroup	Hours	on Key Tasks	% Time on Key Tasks
Senior Mgmt	35.53	4.74	13.3
Sales Devel.	34.38	7.74	22.5
Marketing	48.63	26.16	53.8

Table 9.2 -- Workgroup Collaboration on Key Tasks

Workgroup	# Observed Members	# Key Tasks	Mean Fraction of Observed Group Collaboration/Key Task
Senior Mgmt	5	11	.27
Sales Devel.	4	8	.31
Marketing	3	13	.67

Table 9.3 -- Workgroup Levels of Multitasking (Method B)

Workgroup	Stack Size Running Avg	Peak Value
Senior Mgmt	8.28	12.78
Sales Devel.	3.75	6.10
Marketing	3.71	5.93

(no Tables 9.4 or 9.5)

Table 9.6 -- Simple vs. Compound Episodes

Workgroup	# Episodes			Time (Hours)		
	Simple	Compound	% Compound	Simple	Compound	% Compound
Senior Mgmt	398	154	27.9	35.53	38.85	52.2
Sales Devel.	343	139	28.8	34.38	33.42	49.3
Marketing	508	168	24.9	48.63	33.41	40.7

Table 9.7 -- Durations of Simple and Compound Episodes

Workgroup	Simple Episodes	Compound Episodes
Senior Mgmt	5.36	15.14
Sales Devel.	6.01	14.43
Marketing	5.74	11.93

Table 9.8 -- Features of Compound Episodes

Workgroup		Mean # per Compound Episodes	
	Events	Comm. Events	Tasks
Senior Mgmt	3.79	2.95	2.31
Sales Devel.	2.73	1.38	1.40
Marketing	2.60	1.42	1.40

Table 9.9 -- Communicative Structure of Episodes

Workgroup		Hours in Episodes Consisting of:	
	All Communication	No Communication	Mixture
Senior Mgmt	44.51	7.41	22.46
Sales Devel.	30.14	29.85	7.81
Marketing	43.94	31.05	7.04